THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XX SEPTEMBER, 1928 No. 3

THE SIGNIFICANCE OF PETROUS RIDGE DEFORMATION IN THE ROENTGEN-RAY DIAGNOSIS AND LOCALIZATION OF BRAIN TUMORS*

BY HENRY K. PANCOAST, M.D.

From the Department of Roentgenology, University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

THE most accurate diagnosis and localization of brain tumors usually depends upon the collaboration with the neurologist and neurological surgeon of many men engaged in different specialized lines of medical work, including the roentgenologist. The greatest aid of roentgenology is the finding of direct evidences of intracranial growths, such as the characteristic sellar deformation of pituitary tumors and the far less frequent calcifications of extrasellar lesions or hyperostoses associated with certain meningiomas. The direct evidences of extrasellar tumors are, unfortunately, found in a comparatively few instances. There is, however, a fairly large percentage of cases in which certain indirect evidences are found of more or less diagnostic and even localizing value. Such findings should be very carefully weighed for what they are worth. The neurologist must be able to estimate correctly the reliability of roentgen interpretations, and both he and the roentgenologist together must appraise their importance and bearing on the case and be able to properly correlate them with the acceptable clinical data. New roentgen diagnostic signs must be carefully studied by both neurologist and roentgenologist, and often the pathologist, and checked up by numerous operative or autopsy findings before their real worth becomes an established fact. The roentgenologist must usually be in the position of the one who proposes and the neurologist, neurological surgeon or the anatomist the one who disposes. This is as it should be, for the roentgen examination is too important not to have its findings and interpretations regarded as acceptable facts. Perfect coöperation is the keystone of success and the ultimate diagnostic value of roentgenological findings in any clinic will prove to be in direct proportion to the thoroughness with which coöperation is practised.

In a recent study for statistical purposes covering the roentgenograms of 221 verified brain tumor cases examined from the services of Dr. Frazier and Dr. Spiller, 65 were pituitary, 97 cerebral and 59 cerebellar or angle in location. Of the 65 pituitary cases, the roentgen-ray findings were correct in 58, or 89.2 per cent. In the 97 cerebral cases some positive roentgen-ray evidence of tumor was found in 55, or 56.7 per cent, and in 26, or 26.8 per

* Presented before the Meeting of the PHILADELPHIA ROENTGEN RAY SOCIETY, January 28, 1928.

cent the growth was localized by some means, including ventriculography in a few instances. In the 59 posterior fossa cases there were roentgen-ray evidences arising from tumor in 30, or 50.8 per cent, but in only 2, or 3.4 per cent, was there any localization, and that was by local bone atrophy.

Although increased use of ventriculography and encephalography in the future will no doubt add materially to the localization percentages, this method will continue to be used only in those cases in which neither clinical nor roentgenological localization is possible otherwise. It is very desirable that more be accomplished in the future by the general routine roentgen examination, especially in connection with posterior fossa tumors.

The roentgen-ray evidences of extrasellar growths as now generally recognized may be summarized as follows:

1. *Calcification.* This is a characteristic of cerebral and Rathke's pouch tumors. It was found in 11, or 11.3 per cent of the 97 proven cases reviewed. It was detected in several additional ones, especially as calcification of cyst walls, but these were excluded because no pathological verification could be obtained. Osteomata have not been included. No calcification was found in any cerebellar or other posterior fossa tumors. It is by no means a correct index as to the size of the tumor, except in case of calcified cyst walls.

2. *Hyperostoses Associated with Meningiomas.* This appearance is of definite localization and diagnostic value.

3. *Effects of general increase of intracranial pressure,* due to block in the ventricular system and distention of the ventricles. Unfortunately this is not characteristic of brain tumor alone. It may cause the following appearances:

a. Convolutional Atrophy. This is more apt to be shown and is more marked in young individuals. We have found it more frequently in connection with cerebellar than cerebral tumors.

b. Sellar Deformation. Atrophy of the dorsum sellae is usually ascribed to pressure by the distended third ventricle. The posterior clinoid processes first disappear, leaving a more or less pointed and gradually shortening dorsum, with little or no depression of the fossa floor until late, in contradistinction to the effect of intrasellar tumors. The ultimate result of extrasellar tumors may be difficult to distinguish from that of advanced pituitary growths.

c. Prominence of the sutures is, of course, more commonly found in the young.

d. Thin skull is an accompanying appearance of no particular individual value.

4. *Calcified Pineal Shift.* Calcification of the pineal body has been found to occur in from 45 per cent (Naffziger[1]) to 47.9 per cent (Vastine and Kinney[2]) of all individuals. Shift of the pineal under the influence of tumor pressure was first referred to by Schüller.[3] Naffziger successfully applied the lateral shift in a number of instances for diagnostic purposes. Vastine and Kinney have worked out an admirable method for detecting shifts in any direction.

5. *Local Pressure Effects.* This evidence of tumor is one which still requires considerable coöperative study. The term implies an atrophy of the inner aspect of the skull due to direct pressure of a tumor or arising in some special locality indirectly through the agency of some other medium. It may take on various appearances, depending upon the exact manner in which it is produced. Unfortunately, many of the appearances which may represent pathological conditions may also be found as normal variations and those which may be caused by tumors may also represent evidences of disease other than growths. The inclusion of local pressure effects as evidences of tumors opens up many pitfalls for the roentgenologist.

a. Local Bone Atrophy. By this is meant a localized atrophy of the inner table or some portion of the base due to direct or nearly direct contact of the tumor. The growth may infiltrate the bone, but, on the other hand, it seems probable that many slow-growing tumors at or very close to the vault, and especially those of greater densities or more localized, in contrast with gliomata, produce changes in contour or density of the inner table. The changes may be inconspicuous or inappreciable, but

in a comparatively few instances they are very definitely manifest in the roentgenogram. When so manifest, it is not likely that all of them will be apparent to the surgeon. In our experience the operative proof of juxtaposition of a tumor to such an area is sufficient to confirm roentgen-ray findings even though no bone changes may be noted on inspection. It is inconceivable how a simple pressure atrophy can occur as a result of direct pressure alone. Transmitted pulsation may be the important factor. The enlargement of the porus acusticus associated with acoustic tumors is another example of local bone atrophy, and the atrophy of the dorsum sellae from pressure of the third ventricle or, less frequently, certain suprasellar growths, is still another. The extent of bone atrophy is not necessarily indicative of the size of the tumor.

b. Prominence of vessel grooves and channels, presumably a result of distention of the meningeal vessels or diploic veins is a sign of doubtful value, and admits of very judicious acceptance only when unilateral.

c. Localized atrophy of the petrous bone is mentioned as a separate type of localized bone atrophy simply because it forms the basis for this presentation.

Because of our apparent shortcomings in the diagnosis and localization of cerebellar and angle tumors, we have, during the past few months added the occipital view to our regular routine examination of brain tumor cases. The technique of the exposure is a slight modification of that long ago proposed by Stewart[4] for fractures and the apparently successful method reported by Towne[5] for the demonstration of local bone atrophy due to acoustic tumors. We had employed this view for some time for the simultaneous bilateral demonstration of the deeper lying mastoid cells in the petrous bone and mastoid process (Fig. 1). We believe it should be used in all head examinations as it promises possibilities which are not afforded by lateral stereoscopic roentgenograms. The view is easily obtained by inverting and inclining the Bucky diaphragm equipment (Fig. 6) which we have used for our ventriculographic work during the past year and which has been described by Pendergrass.[6,7]

The ridge of the petrous bone is plainly shown on each side from the articulation with the basilar process (which lies in about the plane of the central rays) all the way out to its junction with the inner table of the skull at the temporoparietal suture. At this point the lateral sinus takes its sharp curve under the ridge and downward to reach the jugular foramen. The petrous ridge is usually sharply outlined and fairly dense throughout its entire extent. When there is unusual mastoid cell development, however, the outer third or outer half of the ridge is very much less dense and may be poorly defined. Fortunately, the two sides are fairly symmetrical as to density, except in case of unilateral chronic mastoid disease, when there may be a decided difference in density on the two sides. Very often the lateral sinus groove can be traced from the torcular Herophili to the junction of the petrous ridge with the side of the skull, where it becomes lost as it dips under the ridge. The location of the internal auditory meatus overlying the jugular foramen and termination of the lateral sinus is not seen, but can be approximately estimated through familiarity with this view (K, Fig. 1).

Attempts have been made by Carr[8] and others to determine the presence of acoustic tumors by the interpretation of deformation of the petrous bone around the porus acusticus from lateral views of the head. This has been both unsuccessful and misleading. In 1926, Towne[5] reported 3 cases of acoustic tumor in which there was shown a very definite erosion of the petrous ridge in the occipital views of the head. We would regard the appearance and the location of the deformation as characteristic of this slow-growing tumor, and Towne's report is a distinct contribution to the roentgen diagnosis of intracranial tumors. The location of such an erosion would be at K, Figure 1, and at the arrow, Figure 5.

When we worked up the limited roentgen-ray statistics on brain tumor cases, previously referred to, our attention had not been called to Towne's report on acoustic tumors, and we started a search by our occipital mastoid view for more

frequent evidences of local bone atrophy as a means of detecting and localizing a larger number of subtentorial and also supratentorial growths in the posterior part of the head, and since then we have employed this view as a routine procedure. The following cases are cited as showing interesting features in connection with the petrous ridge:

FIG. 1. Occipital view of a normal adult head. A, foramen magnum. B, posterior arch of atlas, which should nearly bisect the foramen magnum. C, ridges of the petrous bones. D, condyle of the mandible. E, temporal articular facet for the temporomandibular articulation. G, external auditory canal. H, mastoid process. I, zygomatic arch. J, side of the skull. K, location of porus acusticus overlying the termination of the lateral sinus at the jugular foramen. Both openings are hidden by the edge of the petrous ridge.

FIG. 2. Occipital view of Case 1, showing a petrous ridge deformity on the left side where the tumor was found, although clinically it was presumably on the right side.

CASE REPORTS

CASE 1. Male, aged forty-three. Referred by Dr. Spiller. Symptoms began in March, 1926, with paresthesia around right corner of the mouth, then itching over the right side of the nose and a spreading of paresthesia to the entire right side of the face and frontal region as far up as the level of the ear. This was followed by shooting pains in the region of the right malar eminence. In July, 1926, he began to have tinnitus in the right ear. Later there was noticeable wasting of the muscles of the right side of the face and temporal region. In August, there was deviation of the left eye toward the right. Later there was loss of sensation of pain in the right eye. In February, 1927, failing vision was noticed. The paresthesia then spread to the left side of the head. There were only occasional headaches. Clinically, a *right* sided tumor was suspected.

Roentgen-ray examination of the head, June 20, 1927, showed the following: (1) Sella turcica about top normal in size; (2) rather unusual vessel markings of the vault, more especially on the left side; (3) apparent erosion of the outer portion of the *left* petrous ridge (Fig. 2). Diagnosis—tumor on the *left* side overlying or in close relation with the petrous ridge.

Operation was performed by Dr. Frazier on the left side instead of the right and an extensive flat tumor was found in the base of the middle fossa under the temporal lobe and extending back into the posterior fossa. Most of it was removed. The tumor was very much larger than the defect.

CASE II. Female, aged thirty-four. Referred by Dr. Spiller. Onset of symptoms in 1923. Clinical diagnosis,—left angle tumor. Roentgen-ray examination Oct. 14, 1927, showed the following: (1) Evidence of increased intracranial tension or ventricular distention indicated by partial atrophy of the dorsum sellae and rather prominent sutures (Fig. 3); (2) extensive atrophy of the inner half of the left petrous ridge extending well in to the basilar process (Fig. 4). The appearance is more like that of a direct pressure effect. Operation by

Dr. Frazier revealed a localized left cerebellopontile angle tumor, which was removed.

CASE III. Male, aged nineteen. Referred by Dr. Frazier. Onset of symptoms December, 1924, becoming rapidly worse. Clinical diagnosis, cerebellar tumor. Roentgen-ray examination on May 23, 1925, by usual lateral stereoscopic views was negative. Operation by

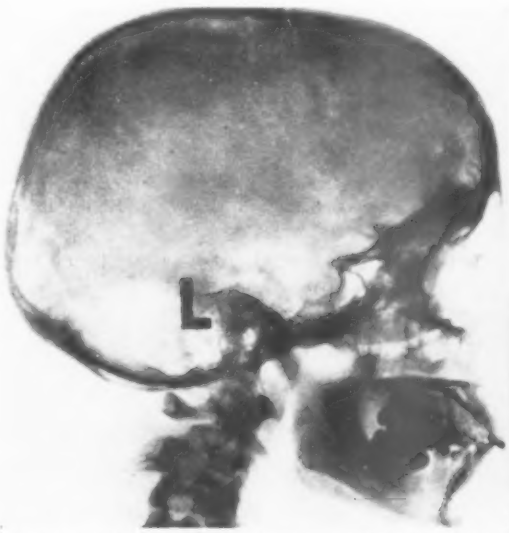

FIG. 3. Lateral view of Case II, showing partial atrophy of the dorsum sellae and rather prominent sutures resulting from ventricular distention.

Dr. Frazier May 30, 1925,—evacuation of a large gliomatous cerebellar cyst, which was larger on the right side. Roentgen-ray treatment followed. Recurrence of symptoms when seen in October, 1926. A similar roentgen examination Oct. 14, 1926, was still negative except in showing the suboccipital decompression. At the second operation Nov. 4, 1926, by Dr. Grant, a solid tumor and recurrent cyst were found in the right cerebellar hemisphere. The tumor and most of the cyst wall were removed. Biopsy showed glioma. Operation was again followed by roentgen-ray treatment. There was another recurrence of symptoms in September, 1927. In a third roentgen examination on Sept. 28, 1927, the occipital view for the first time used on this case, showed, in addition to the opening, an extensive bone atrophy of the right petrous ridge. At the third operation by Dr. Frazier two days later the cyst and most of the tumor were removed.

CASE IV. Female, aged twenty-one. Referred by Dr. Spiller. Onset of symptoms in April, 1926. Clinical diagnosis of a tumor suspect made but localization in doubt, and it was decided not to advise operation, at least for the present. Roentgen examination on Nov. 4, 1927, showed in the occipital view a slight deformation in the outermost portion of the left petrous ridge. The examination was otherwise negative. This apparent deformation is almost too slight to form the basis of a positive opinion on diagnosis or localization, as similar appearances have been noted in a very few normal heads.

CASE V. Female, aged fifty. Referred by Dr.

FIG. 4. Occipital view of Case II, showing extensive atrophy of the left petrous ridge rather far in. This appearance was regarded as confirmatory of a clinical diagnosis of left angle tumor, which was found at operation.

Spiller. Duration of symptoms two years. Clinical diagnosis of probable brain tumor was made but no localization was possible. Operation was not advised for the present. Roentgen-ray examination Nov. 17, 1927, showed in the occipital view a localized bone atrophy in the outer portion of the left petrous ridge.

CASE VI. Male, aged thirty-seven. Referred by Dr. Spiller. Onset of symptoms eighteen months ago with vertigo, which has been a prominent feature ever since. The diagnosis of tumor was in doubt and if one was present, its localization was very uncertain. A Queckenstedt test suggested by Dr. Cadwallader was reported positive on the left side, but a later opinion was expressed that the difference on the two sides was within top normal limits. Roentgen-ray examination on Dec. 5, 1927, showed in the lateral views a very prominent vessel groove on the left side, and the occipital view revealed a rather marked depression in the outer portion of the left petrous ridge, similar to that found in Case I.

Our first apparent successes in determining petrous ridge deformities and connecting them possibly with tumors were most

encouraging, but an additional case recently operated upon proved to be most disappointing because the tumor was found at operation upon the side *opposite* to the petrous ridge deformation, and this was confirmed at subsequent autopsy. The notes in the case are as follows:

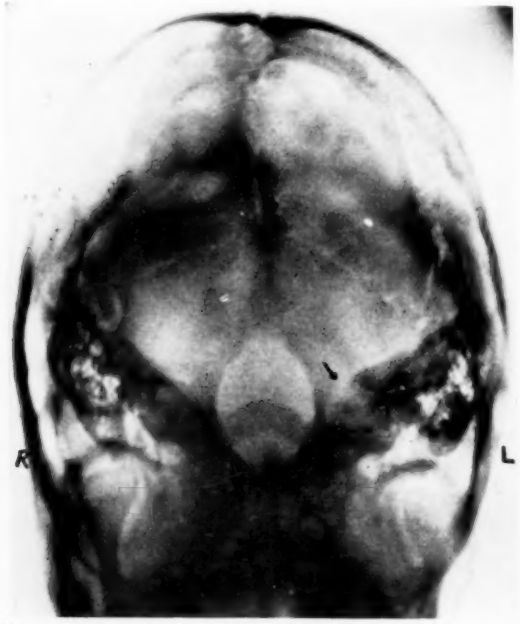

Fig. 5. Occipital view of Case VIII, showing the increased diameter and prominence of the left internal auditory canal and the rarefaction of the petrous bone in the neighborhood of the internal meatus due to an acoustic tumor.

Case VII. Male, aged forty. Referred by Dr. Frazier. Onset of symptoms about two years ago with headache, vomiting and buzzing in left ear. Clinical diagnosis *left* cerebellopontile angle tumor. Roentgen-ray examination on Sept. 28, 192-, showed in the occipital view a definite depression in the *right* petrous ridge, which was regarded as possible evidence of a right sided tumor, supratentorial or angle. At operation by Dr. Frazier a *left* angle tumor was exposed. The patient later died of pneumonia and the operative findings were confirmed at autopsy.

Case VIII. Female, aged nineteen. Referred by Dr. Frazier. Suspected left cerebellar or angle tumor. Roentgen-ray examination on Jan. 31, 1928, showed in the occipital view an increased diameter and prominence of the left auditory canal and a decided rarefaction of the petrous bone around the internal meatus. This appearance was regarded as indicative of a left acoustic tumor (Fig. 5). This diagnosis was confirmed at operation. This case is cited simply for the purpose of showing the difference in location of acoustic tumors from that of other growths in this neighborhood. The appearance is practically identical with that described by Towne.[5]

Still another case recently operated upon revealed a tumor on the side opposite to a slight petrous ridge depression which had not, however, been regarded as sufficient for a positive diagnostic sign.

The apparent uncertainty or unreliability of petrous ridge deformities as an evidence of tumors in all instances in which it is found has led us, first, to seek the explanation for the atrophy when it is due to tumor and, secondly, to determine the frequency, extent and possible causes of irregularities in outline of the ridge under normal conditions, in order that others may not be misled. We have regarded the matter of deformities in a definite locality arising from the pressure of the slow-growing acoustic tumors as settled (Fig. 5).

It has seemed possible that petrous ridge deformation might, aside from infiltration by that type of growth, arise through two different agencies—direct tumor contact and obstruction to the lateral sinus as by an angle tumor. It seems most likely that these, like most other instances of local bone atrophy directly or indirectly arising from brain tumor, must, in a large measure, be dependent upon pulsation. We have as an analogy elsewhere in the body the rather rapid and extensive pressure atrophy of the vertebrae or sternum in the presence of direct aneurysmal pressure or the widespread destruction of vertebrae said to be due to the presence of a cold abscess so placed as to take up the cardiac pulsation, whereas large non-infiltrating intrathoracic, abdominal or pelvic tumors not transmitting pulsation may exist for a long time and be closely confined without causing any bone atrophy. Long-continued pulsation transmitted to various media of greater density, as tumors next to bone, the third ventricle in the case of the dorsum sellae, engorged vessels and venous lakes, Pacchionian bodies or even the convolutions, may, to a

greater or less degree, be accountable for the bone changes often found adjacent to them.

On this basis we might easily explain petrous ridge atrophy arising from an overlying supratentorial growth, as in Case 1. It has seemed possible, as the second cause, that long-continued obstruction to a lateral sinus at or near the jugular foramen, as by a slow-growing angle tumor, might cause dilatation above sufficient to produce localized atrophy of the ridge at one of the deepest points of the sinus groove where it turns downward just under the outermost portion of the petrous ridge. This point is much farther out than the location of the acoustic tumor defect. Naturally, rapidly growing tumors would not be expected to produce any defects.

A study of 117 normal occipital roentgenograms made according to the technique described showed that the petrous ridge was fairly symmetrical on the two sides in 108, or 93 per cent. In 4 other instances there was a slight depression on one or the other or both sides, noticeable in the posteroanterior, but not in the occipital view. These 4 instances have been sufficient to cause us to discard any but the occipital roentgenograms as reliable. Eliminating these 4 brings the symmetry by the latter view up to 112, or 95 per cent. In the 5 remaining cases we found an appreciable ridge depression on the right side in 4 instances and on both sides in one. In only one right-sided depression was there a distinct enlargement of the right lateral sinus. Piersol[9] and other anatomists state that the right lateral sinus is usually the larger and that the longitudinal sinus very often opens directly into it. This occurs less frequently on the left side.

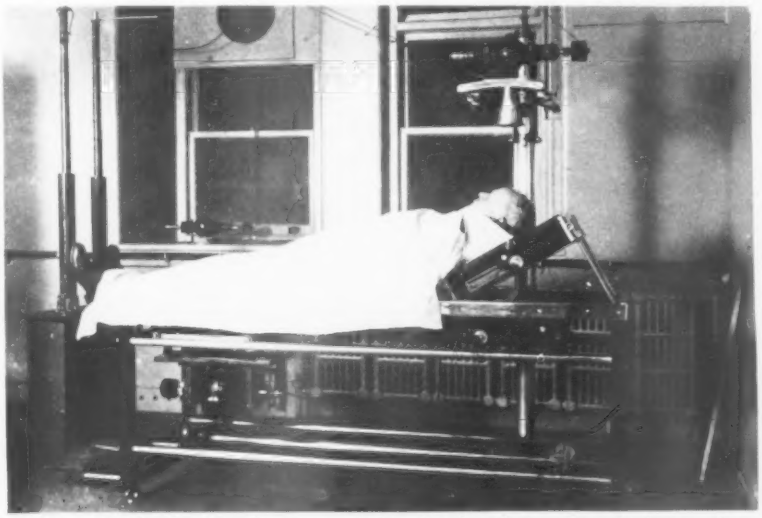

Fig. 6. Illustrating the method of using the inverted flat Bucky device for obtaining views of the occipital region and petrous bones. Two of the legs are removed for this purpose and the Bucky is turned over. The two remaining legs are thrust through and hold the device in the inclined position.

There may, therefore, be normal depressions in the petrous ridge on either side, but more frequently on the right, hence one should be very wary about placing too much significance upon petrous ridge deformation outside the location of the porus acusticus. Apparent deformation must be very carefully interpreted with the clinical data in all cases. Slight defects had better not be regarded as significant at all, and especially on the right side. Rapidly growing tumors unless infiltrating, are hardly likely to produce defects. One must be careful not to be confused by the appearance of unilateral chronic mastoid disease.

The occipital view should always be made in the examination of all brain tumor suspects because bone changes can be shown by it which can escape notice in stereoscopic lateral views.

REFERENCES

1. Naffziger, H. C. A method for the localization of brain tumors—the pineal shift. *Surg., Gynec. & Obst.*, 1925, xl, 481–484.

2. VASTINE, J. H., and KINNEY, K. K. The pineal shadow as an aid in the localization of brain tumors. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xvii, 320–324.
3. SCHÜLLER, ARTHUR. Roentgen Diagnosis of Diseases of the Head. Trans. by F. F. Stocking. C. V. Mosby Co., St. Louis, 1918.
4. STEWART, W. H. Skull Fractures Roentgenologically Considered. Paul B. Hoeber, New York, 1925.
5. TOWNE, E. B. Erosion of the petrous bone by acoustic nerve tumor; demonstration by roentgen ray. *Arch. Otolaryng.*, 1926, iv, 515–519.
6. PENDERGRASS, E. P. A new arrangement of the Bucky diaphragm for ventriculography. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xvii, 358–359.
7. PENDERGRASS, E. P. A new arrangement of the Bucky diaphragm for encephalography. AM. J. ROENTGENOL. & RAD. THERAPY, May, 1928, xix, 482–484.
8. CARR, GLADYS L. Roentgen ray findings in the skull in cases of brain tumors, with special reference to the porus acusticus. AM. J. ROENTGENOL., 1917, iv, 405–410.
9. PIERSOL, G. A. Human Anatomy. J. B. Lippincott Co., Philadelphia.

THE ROENTGENOLOGICAL STUDY OF THE NECK

BY

SAMUEL BROWN, M.D. AND HAROLD G. REINEKE, M.D.

Roentgenologist, Jewish Hospital; Assistant Attending Roentgenologist, General Hospital

Radiographer, General Hospital

CINCINNATI, OHIO

THE roentgenological study of the soft tissues of the neck has received very little attention on the part of roentgenologists. This lack of interest is, in our opinion, due to the greater difficulty in the technique of rendering the soft parts visible on the roentgen film. We find only two reports in the medical literature of this country calling attention to the soft structures of the neck. Iglauer[1] has presented an excellent paper dealing chiefly with the larynx. The roentgenograms which formed the basis of his work were made by Dr. Sidney Lange. The second report is by Pfahler[2] who dealt chiefly with the thyroid and its relation to the esophagus and trachea. In order to overcome the technical difficulties associated with the demonstration of the soft tissues we adopted the position devised by Grandy[3] in making lateral views of the neck for demonstration of the cervical vertebrae. We have found that with a little care, one can make satisfactory views of the average neck with considerable detail in the soft tissues.

TECHNIQUE

The anteroposterior view of the neck is of little value in the visualization of the soft tissues, due to the superimposition of the cervical vertebrae. The lateral view is the one which yields the most information. The individual to be examined stands or sits with his shoulder, right or left, against the stereoscopic plate changer. Stereoscopic views may thus be obtained, but this we find not to be essential. One good view is sufficient for most practical purposes. The head and neck are held absolutely parallel to the plate changer. Occasionally it is necessary to hold the head immobile during an exposure. The hand of an assistant placed over the head serves the purpose. A mechanical device may prove of greater value and this we are now in the process of constructing. In this position the neck is several inches away from the cassette, but the little magnification which results is of no consequence. The target of the tube is $3\frac{1}{2}$ feet from the cassette. The central ray is directed at the middle of the neck. The voltage does not exceed a 5 inch spark gap and the current is about 20 ma. The exposures range from $\frac{1}{2}$ to 1 second, depending upon the size of the individual.

THE ROENTGENOLOGICAL ANATOMY OF THE NECK

The cervical spine occupies the posterior half of the neck. At times the first and

FIG. 1. Lateral view of the neck of an average individual. Note the pharynx, larynx and trachea.

FIG. 2. The stylohyoid ligament is calcified. The thyroid and cricoid cartilages are distinctly differentiated. Note the uniformity in the calcification of the thyroid cartilage. (Male.)

FIG. 3. The nasal and oral portions of the pharynx are displaced forward by a new-growth in the retro-pharyngeal region.

FIG. 4. The trachea shows loss of parallelism as a result of pressure on the anterior wall by an enlarged thyroid gland.

second dorsal vertebrae can also be seen. In front of and parallel to the anterior surface of the spine lie the pharynx, larynx and trachea. These structures are transparent and in outline resemble a pistol. The pharynx, which occupies the upper two-thirds, corresponds to the handle of the pistol; the larynx, to the firing mechanism; the trachea, to the barrel. The pharynx is broad above where it

FIG. 5. Note the non-uniform calcification of the larynx. (Female.) The anterior wall of the trachea is slightly depressed by an enlarged thyroid gland.

FIG. 6. The findings are more marked than in Figure 5. The thyroid gland shows a calcified layer in its upper portion.

communicates with the nasal and oral cavities. Below, opposite the fifth and sixth cervical vertebrae, it joins the esophagus. The line of demarcation between the pharynx and esophagus is very distinct, the latter being collapsed and free from air and therefore relatively opaque to roentgen rays. The posterior wall of the pharynx is straight, while the anterior wall is concave. Above, the pharynx is crossed diagonally by the rami of the mandible which decreases its transparency. Below, the tip of the epiglottis is seen to project from the anterior wall. During deglutition there is almost complete loss of transparency in the whole of the pharyngeal region due to the contraction of the pharyngeal muscles which obliterates the pharyngeal cavity. The portion of the esophagus which is in the neck lies in

FIG. 7. The thyroid gland is enlarged both in front and behind the trachea. The anterior wall is somewhat irregular but the trachea is not compressed.

FIG. 8. Marked enlargement of the thyroid with calcified deposits. Enlarged thyroid gland is seen behind the trachea. The walls of the latter are irregular and compressed.

FIG. 9. Two soft masses are seen to arise from the anterior wall of the pharynx. The lower mass is located just above the larynx. These were found to be due to carcinoma at the base of the tongue.

FIG. 10. Foreign body in the esophagus causing forward displacement of the trachea.

FIG. 11. Retropharyngeal abscess causing forward displacement of the pharynx, larynx, and trachea in a boy five years old.

FIG. 12. Retropharyngeal abscess in a baby one year old. The pharynx, larynx, and trachea are displaced forward.

front of the lower cervical vertebrae and behind the larynx and trachea. The shadow which represents it is about three times broader than the space between the posterior pharyngeal wall and the anterior borders of the vertebrae and is relatively opaque (see Fig. 1).

In front of the pharynx and below the jaw is seen the hyoid bone. Its position depends upon the act of swallowing. During the act it ascends and is brought closer to the border of the mandible. Infrequently the stylohyoid ligament is

found to be ossified (Fig. 2). The degree of visualization of the larynx will depend upon the age of the individual. The older the individual, the more calcified are the laryngeal cartilages and thus the more readily visualized by the roentgen rays. There appears to be a difference in the manner in which calcification takes place in males and females. In the former it is of a more uniform character, while in the latter it is more mottled. Dr. Hickey, in a recent conversation with one of us (S.B.), made this observation (see Figs. 2 and 5). The thyroid cartilage is seen in profile and the cricoid cartilage lies below it (Fig. 2). The epiglottis has the shape of a leaf and is seen to extend upward and backward from the upper surface of the thyroid cartilage. The other cartilages which make up the larynx cannot as yet be differentiated by means of roentgen rays. In some views of the neck the aperture between the vocal cords can be seen (Fig. 1).

The cervical portion of the trachea lies in front of the esophagus. In front of the trachea are seen the soft tissues of the neck which cannot be differentiated unless the thyroid gland is enlarged. The anterior and posterior walls of the trachea are almost parallel to each other. In individuals with short necks this parallelism is lost. Normally its caliber grows slightly narrower in its downward course.

Under normal conditions, the thyroid gland is not differentiated but when enlarged it can be readily recognized. Abnormal changes within the gland and changes produced in the neighboring structures, such as the trachea, can be readily detected.

CONCLUSIONS

The lateral view of the neck enables the visualization of the soft tissues, which has proven to be of some practical value in the study of these structures, especially of the thyroid and trachea. Though this work is relatively new, physicians have already become interested, as shown by the number of requests we receive for such examinations. Thus far, we have found very little of practical value in the study of the larynx. However, in time we may learn to recognize abnormal conditions in this organ.

A number of illustrations have been chosen from a large collection of cases to demonstrate the value of this type of examination.

REFERENCES

1. IGLAUER, SAMUEL. Value of roentgenography in diagnosis of diseases of the larynx and trachea. *J. Am. M. Ass.*, 1914, lxiii, 1827–1830.
2. PFAHLER, G. E. New roentgenographic technique for the study of the thyroid. AM. J. ROENTGENOL., 1921, viii, 81–83.
3. GRANDY, C. C. A new method for making radiographs of the cervical vertebrae in lateral position. *Radiology*, 1925, iv, 128–129.

MASSIVE (ATELECTATIC) COLLAPSE OF THE LUNG*

WITH REPORT OF A CASE SHOWING ASSOCIATED SPONTANEOUS PNEUMOTHORAX

BY L. R. SANTE, M.D.

ST. LOUIS, MISSOURI

MASSIVE collapse of the lung is a condition in which, without apparent cause, one or more lobes of the lung lose their air content and collapse. Since this condition was first described in 1890 by Pasteur[1, 2, 3] following 34 cases of post-diphtheritic paralysis of the diaphragm, it has been reported by many others in association with a wide variety of conditions. Extensive studies of the condition have been made by Elliott and Dingley,[4] Bradshaw,[5] Crymble,[6] Bradford,[7] Briscoe,[8] Scrimger,[9] Elwyn and Girsdansky,[10] Regan,[11] Ritvo,[12] Holmes,[13] Scott,[14] Jackson and Lee,[15] and Hearn and Clerf.[16]

Massive atelectatic collapse of the lung occurs most frequently as a postoperative complication following abdominal operations. It has been described following fracture of the femur or pelvis and as a result of injury, sometimes trivial, to the chest, abdomen or buttocks. It occurs following post-diphtheritic paralysis of the diaphragm, septicemia and poliomyelitis. Two cases are on record where bilateral total collapse occurred on the operating table in women undergoing pelvic operations. One case is reported in which collapse occurred twice in the same individual, after kidney operations undertaken at different times.

To the reported cases we have added 4 others,[17, 18] each having some unusual feature. During the observation of these 4 patients it was demonstrated that *merely rolling the patient on the uninvolved side with the collapsed lung uppermost and causing him to cough would cause reinflation of the collapsed lung under direct roentgenoscopic vision.*

No instance could be found in the literature of massive atelectatic collapse of the lung associated with pneumothorax. The two conditions would seem to be paradoxical; if the lung is atelectatic and totally devoid of air, how could its rupture cause spontaneous pneumothorax. For this reason we felt that the report of such an unusual case would be of interest.

Such a case, which I wish to report at this time, occurred in the service of Dr. Wm. G. Herrman, who made the examination and to whom I am indebted for this report.

CASE REPORT

E. F., a thin, somewhat emaciated white male patient, aged nineteen. On admission, Dec. 22, 1926, he showed marked dyspnea and cyanosis, and had to sit up in bed to get his breath. Nothing in the past history was of significance other than a history of asthmatic attacks for the past several years. Just prior to his admission to the hospital while suffering from one of these asthmatic attacks he had experienced a sharp pain in the chest.

Extract of Dr. Herrman's findings on physical examination: "Physical examination at this time revealed immobility of the entire left chest. This was very marked and quite striking on inspection of the chest. Tactile fremitus absent throughout the entire left chest with exception of a small area posteriorly about the level of the spine of the scapula. Percussion showed hyperresonant note and a tendency to tympany over the 1st, 2d, and 3d interspaces anteriorly and over the area extending from the apex to about the level of the spine of the scapula posteriorly. Below this, there is absolute dullness. Auscultation revealed absence of breath sounds throughout the left chest. Right chest negative with exception of few mucous râles diffusely distributed. Over the area of dullness above described there is heard some extraordinary adventitious sounds difficult to describe. No coin or succussion splash was elicited.

"The apex beat of the heart was in the 5th interspace in the anterior axillary line, regular in rate and rhythm."

The temperature at first ranged as high as 103.2° F., but later fell gradually and reached normal, Dec. 24.

Roentgenographic examination immediately after admission (Fig. 1) revealed massive col-

* From the Department of Radiology, St. Louis University School of Medicine and St. Louis City Hospital. Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20-23, 1927.

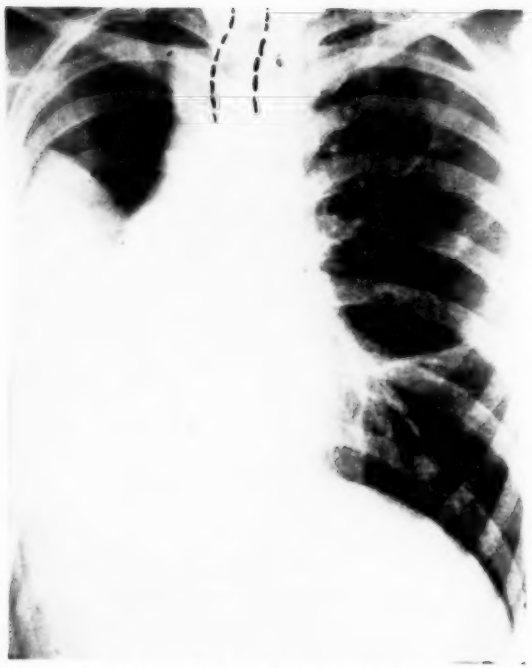

FIG. 1. Massive collapse of the entire left lung with associated spontaneous pneumothorax coming on suddenly following an asthmatic attack. There is little, if any, narrowing of the chest on the involved side and the position of the ribs and interspaces are not disturbed. This is probably because the pneumothorax takes up a part of the space lost from collapse of the lung and therefore releases the tension which would otherwise be exerted upon the chest wall. There is slight deviation of the mediastinum.

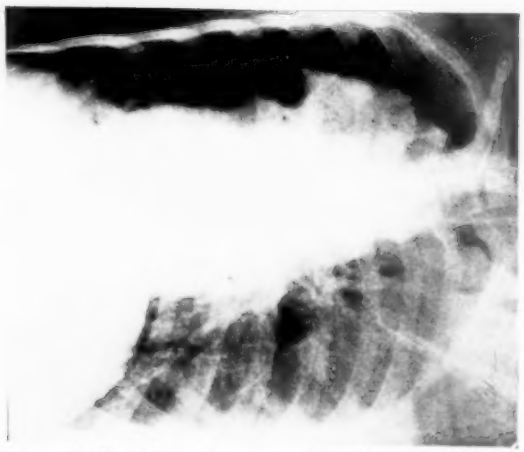

FIG. 2. Rolling the patient upon his uninvolved side disclosed a rounded circular area in the lower portion of the upper lobe which still was air containing. It is possible that this small aerated area might have been unaffected by the collapse and its expansion to compensate for the loss of space incident to collapse of the remainder of the lung may have resulted in its rupture and accounted for the spontaneous pneumothorax. On assuming this position the lower lobe reinflated.

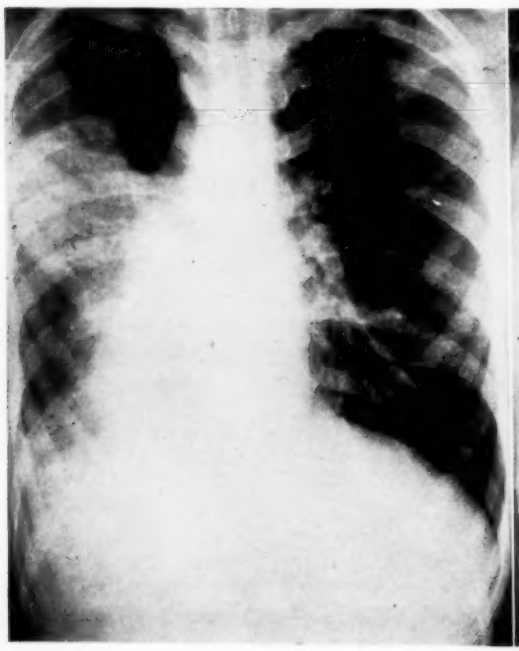

FIG. 3. A short time later; note partial reinflation and the partial remaining pneumothorax of the upper chest.

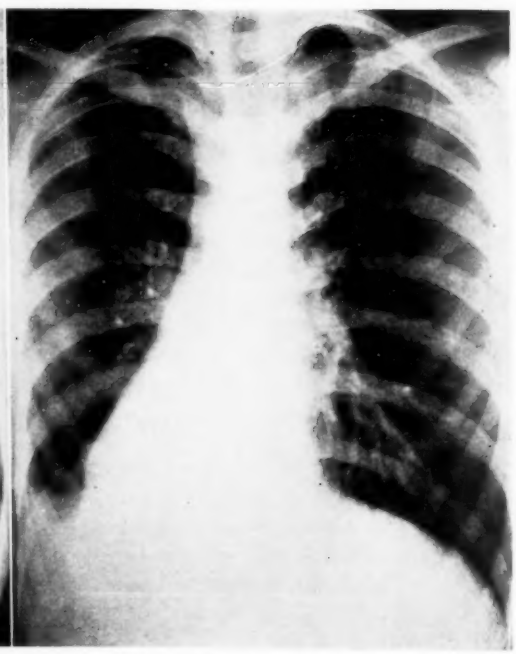

FIG. 4. Three days later; complete reinflation and absorption of pneumothorax.

lapse of the left lung with associated pneumothorax. Since the existing pneumothorax was sufficient to partly equalize the pressure caused by the collapse of the lung no narrowing of the chest, displacement of the mediastinum or elevation of the diaphragm was produced; slight tracheal displacement toward the involved side was noted. Two days later (Fig. 2), Dec. 24, 1926, the patient was brought to the roentgenoscopic room and rolled over on the unaffected side. The lower lobe cleared, and a small rounded area was noted in the consolidated lobe. The upper lobe cleared partially also, but the pneumothorax was still quite evident. Three days later (Fig. 3), Dec. 27, 1926, examination revealed almost complete reinflation of the lung, only a very slight pneumothorax remaining. The patient went on to an uneventful recovery (Fig. 4) and left the hospital on Jan. 5, 1927.

The unusual aspect of this case is the association of pneumothorax with the massive atelectasis. It is hard to conceive how a lung totally atelectatic might rupture and produce a spontaneous pneumothorax. Figure 2 shows a small rounded area of uncollapsed lung at the lower margin of the upper lobe; it seems possible that this might have been the source of the pneumothorax. If a single lobe collapses, the loss in volume due to the collapse of the lung is easily compensated for by the emphysema which results in the remaining aerated lung. If, however, only a very small segment of a lobe is all that remains uncollapsed, then the strain under which this small segment is placed is very great in its effort to expand and compensate for the loss in volume, and it may even burst giving rise to pneumothorax. It seems quite probable that such a condition occurred in this instance. The rapid reinflation on rolling the patient onto his uninvolved side seems rather remarkable.

REFERENCES

1. PASTEUR, W. Respiratory paralysis after diphtheria as a cause of pulmonary complications, with suggestions as to treatment. *Am. J. M. Sc.*, 1890, c, 242–257.
2. PASTEUR, W. The Bradshaw Lecture on massive collapse of the lung. *Lancet*, 1908, ii, 1351–1355.
3. PASTEUR, W. Massive collapse of the lung. (Syn. active lobar collapse.) *Brit. J. Surg.*, 1914, i, 587–601.
4. ELLIOTT, T. R., and DINGLEY, L. A. Massive collapse of the lungs following abdominal operations. *Lancet*, 1914, i, 1305–1309.
5. BRADSHAW. Cited by Holmes (Ref. 13).
6. CRYMBLE, P. T. Gunshot wounds of the chest. *Brit. J. Surg.*, 1918, v, 363–388.
7. BRADFORD, J. R. Oxford Loose Leaf Medicine, 1920, ii, 127.
8. BRISCOE, J. C. The mechanism of postoperative massive collapse of the lungs. *Quart. J. Med.*, 1919–20, xiii, 293–335.
9. SCRIMGER, F. A. C. Postoperative massive collapse of the lung. *Surg., Gynec. & Obst.*, 1921, xxxii, 486.
10. ELWYN, H., and GIRSDANSKY, J. Postoperative massive collapse of the lung. *J. Am. M. Ass.*, 1922, lxxix, 718–720.
11. REGAN, J. C. Massive collapse of the lung in acute poliomyelitis. *Lancet*, 1924, ii, 1222–1224.
12. RITVO, MAX. Massive collapse of the lungs. AM. J. ROENTGENOL. & RAD. THERAPY, 1924, xi, 337–342.
13. HOLMES, G. W. Massive collapse of the lung. AM. J. ROENTGENOL. & RAD. THERAPY, 1924, xi, 509–516.
14. SCOTT, W. J. M. Postoperative massive collapse of lung. *Arch. Surg.*, 1925, x, 73–116.
15. JACKSON, C., and LEE, W. E. Acute massive collapse of lungs. *Ann. Surg.*, 1925, lxxxii, 364–389.
16. HEARN, W. P., and CLERF, L. H. Postoperative massive collapse of the lung. Report of bronchoscopic observations. *Ann. Surg.*, 1927, lxxxv, 54–60.
17. SANTE, L. R. Massive collapse of the lung. *Radiology*, 1927, viii, 1–13.
18. SANTE, L. R. Massive collapse of the lung. *J. Am. M. Ass.*, 1927, lxxxviii, 1539–1542.

DISCUSSION

DR. W. F. MANGES, Philadelphia. This is an important subject, and it has been presented in a most able and interesting manner. For the most part, I can do nothing more than emphasize what Dr. Sante has said. However, I don't think that one should take up this subject of massive collapse without qualifying it: either say massive collapse following abdominal operation, which is one thing, or massive collapse following lesions within the chest, which is an entirely different thing. That is, we have massive collapse following abdominal operations or trauma outside of the thoracic area and we have massive collapse of the lung in primary carcinoma of the bronchus, occasionally due to enlarged mediastinal root glands, and frequently in the case of foreign bodies in the bronchi.

I am personally convinced, from more or less observation of all of these varieties, that the matter of bronchial obstruction plays a very important part; that is, that the true atelectatic element, the absence of air in the lung, is due to obstruction of a bronchus.

A very interesting case was in a boy who had had an obstruction of the esophagus following the swallowing of lye. For a year or more he had been under treatment for dilatation of the stricture; he had been fed through a gastrostomy wound. His esophagus had finally been dilated to a caliber of more than half an inch and it was considered satisfactory. The gastrostomy wound was closed—a rather simple

operation. Two days later the boy more or less rapidly manifested signs of distress; as Dr. Sante has said, sometimes that distress in these cases is of a dyspneic character and at other times referable to other functions. In this case the distress was largely dyspneic. We x-rayed the boy and found he had an acute collapse of the entire left lung. That observation was made within a matter of hours from the onset, certainly within a matter of twelve hours of the first onset of symptoms. Within twenty-four hours of that time the lad was bronchoscoped and his bronchi were cleared by means of a suction apparatus through a bronchoscope.

The exudate was extremely thick, viscid, tenacious, and when put into a test tube and the test tube inverted it would not run out. On the table, as the exudate was being removed, we could see air entering the lung, and we proved absolutely by means of roentgenograms taken at inspiration and expiration, that that lung assumed function immediately after the bronchi had been aspirated. So in that case, as in others in which it has been proven in the same way, there is not a lack of muscular function or power to take in air and expel it. It is not taken in because it can't get in. I am convinced also that there is some element of disturbance of innervation. I am convinced of that largely because it almost always happens that the atelectasis occurs on the side of operation; that is, when an appendix operation is followed by an atelectatic process, the atelectasis is on the right side. In the case of this boy, the atelectasis—the wound being to the left of the median line—was on the left side. There are cases in which the reverse is true, but as a rule the atelectasis occurs on that side, and there is the absence of motion of the diaphragm even when the bronchi are cleared out, as Dr. Sante has pointed out.

The fact of there being a leucocytosis and a rise of temperature does not necessarily imply that this is an acute infectious process. I think that you can have a leucocytosis and an elevation of temperature from absorption of materials that are the result of an irritation other than an infection.

Paralysis of the diaphragm is not primarily a cause of atelectasis because we see that so frequently in other conditions. It is remarkable how rapidly a lung will undergo complete atelectasis and how rapidly it will again resume complete function if the obstruction is removed. Within a period of twenty-four hours, I have seen complete collapse of an entire lung develop, of three lobes on the right side, and again resume normal function. The process of absorption by way of the blood stream therefore is rather rapid. In one instance I predicted that on the following day there would be an atelectasis of a lung. Those of you who have followed my talks about obstructive emphysema will recall that I said when obstruction to inspiration becomes almost complete so that the ingress of air is no more rapid than the absorption of the air, then that chest affected will not change during inspiration and expiration. If the obstruction becomes just a little more nearly complete so that absorption gains the ascendency, then that lung begins gradually to contract, and observations made almost from hour to hour will demonstrate that one or the other process is in the ascendency. So I in one instance said, "This child is entering a stage of atelectasis very gradually." The following day it had no air shadow and had marked contraction over the left lung. In that instance, the child had been bronchoscoped previously for a supposed foreign body. Dr. Jackson passed a bronchoscope, found a congenital membrane across the orifice of the main bronchus on the left side, and in that membrane there were just three tiny holes which at the time of the collapse were like little dimples. He passed tiny tubes through and air entered. That membrane had become inflamed and swollen to such an extent that those tiny holes had closed up and the air did not enter and there was collapse. When obstruction was removed by the inflammation disappearing, that lung again resumed function.

I want to try to make myself understood on this point, and I think that it is the only point that I have to make: That there is not collapse of lung tissue without bronchial obstruction, whether it be foreign body, whether it be pressure from without, or whether it be due to the presence of exudate that develops within the bronchus, and I think the primary cause of collapse is in the bronchus, and perhaps in fairly large bronchi, and not in the lung tissue; that is, not in the parenchymal portion, and not due to paralysis of the diaphragm.

DR. H. K. TAYLOR, New York City. Experimental work done by Dr. Coryllos at the Loomis Laboratory, Cornell Medical College in New York City, has repeatedly demonstrated that by obstructing one of the larger bronchi you will always produce an acute massive collapse of the lung. He has bronchoscoped quite a number of dogs and ingeniously devised a mechanism whereby he can insert a balloon in a collapsed state and inflate it to obstruct the bronchus completely, and within a period of twenty-four hours, taking roentgenograms serially every twenty-four hours, he has demonstrated a gradual massive collapse of the entire lung. Removing this balloon, he has always shown a gradual aeration of the lung to its

normal appearance. He has repeatedly performed this and his results will shortly be published.

Dr. Merrill C. Sosman, Boston. I should like to confirm what Dr. Sante has said, and I think the most important part of his paper is the treatment of this condition. The patients certainly are sick and uncomfortable; they are very dyspneic, very cyanotic, with a high temperature and high pulse, and since hearing his paper last December I have seen two cases of acute massive atelectasis clear up very rapidly by turning the patient on the sound side and manipulating him or shaking him or patting him on the back, as you would a baby who has swallowed a foreign substance, and the patient will usually cough up a large quantity of mucus, and immediately feel much better. I believe the important part of his paper is the use of this method in treating these cases.

Dr. Sante (closing). I think Dr. Manges' point is very well taken, that when mentioning massive collapse it should always be qualified, and I think that qualification should take the form of the word "atelectasis" in contradistinction to the collapse of the lung that you get in association with pneumothorax. I think at least that qualification should be made and that the term should be mentioned as "massive atelectatic collapse of the lung" rather than "massive collapse of the lung," or as suggested by Dr. Hirsch, "massive idiopathic lobar atelectasis."

I have become quite convinced that what Dr. Manges says is the true method of collapse; that atelectasis is due in some way to the obstruction of a bronchus. I believe that the atelectasis is due to the obstruction of a bronchus, but there is some other nervous element also associated. It isn't a paralysis of the diaphragm; it is a defense reaction, not a spasm. This is always present and it is sometimes on the other side on which the trauma is effected, so that I think a nervous reflex action precedes the obstruction of the bronchus, although the atelectasis could follow the obstruction by mucus. In no case have we aspirated or seen coughed up any greater quantity of mucus than would exceed 1 or 2, or at the most 5 cubic centimeters. The mucus tallies exactly with that described by Dr. Jackson and Dr. Manges as gumdrop-like, and, as he said, still sticks to the bottom of the test tube when inverted. You can see how mucus of that consistency might stick to the bottom of the bronchus. It is conceivable that a person as seen in the army, where he was very intense upon a certain position, might acquire a cough reflex or a reflex which would permit the concentration of this substance, which might result in collapse when assuming this position. You can conceive in asthma why this condition might occur, but it is difficult to see in all of these cases why the diaphragm should have become immobilized on the affected side.

I want to thank Dr. Sosman for his confirmation of this method of treatment and I have had a number of confirmations by other men who have done the same thing. Merely by rolling the patient on the sound side and causing him to cough, in some way dislodges this mucus from the bronchus and permits it to continue re-inflation.

DIVERTICULA OF THE STOMACH

BY WILLIAM K. KALBFLEISCH, M.D.

From the Roentgen Ray Department of the Wheeling Clinic

WHEELING, WEST VIRGINIA

COMPARED with the relative frequency of diverticula of the intestinal tract, a diverticulum of the stomach in man is a rare finding. Before the roentgen era, there were only a few operative and post-mortem cases reported; since then, the diagnosis has been made more often, but even now, the occurrence of such a case is rare enough to justify publication.

CASE REPORT

Mrs. W., aged thirty-nine, married, white.

Current Complaint. Dull ache in right lower quadrant.

Previous History. Patient had typhoid fever when a child. She had pneumonia when thirteen years of age. She states that she never had a serious accident. Her tonsils were removed five years ago. Marital history: Married fifteen years; one child is living and well, one died at six years of age of typhoid fever. Both were normal deliveries. Patient had no miscarriages.

Present Illness. About one year ago the patient began to have pain in the right lower quadrant of the abdomen. The pain has never been very severe but it has been quite constant. There is no direct relation to the intake of food. She complains of a great deal of gas in stomach and bowels.

The physical examination was essentially negative except for tenderness low down in the right lower quadrant of the abdomen. The vaginal examination showed the fundus uteri anteverted, anteflexed and freely movable. The left ovary could not be palpated; the right was palpable but not tender. There was, however, a decided pain on palpation in the right iliac fossa. The rectal examination was negative. Urine and blood examinations gave normal findings. The Wassermann reaction was negative and the temperature normal.

A provisional clinical diagnosis of chronic appendicitis was made and the patient was advised to have a roentgenological examination of her gastrointestinal tract.

Report of the roentgen examination of the gastrointestinal tract made May 23, 1927.

Stomach long and orthotonic, axis vertical, position on the left of the spine. Small round pylorus in front of the fifth lumbar vertebra. Triangular shaped duodenal bulb also in front of the spine. The outline of stomach and bulb is smooth, no niche, spasm or defect seen. There is, however, inside the gas bubble of the cardia, another long, narrow and dark shadow like a second gas bubble with a fluid level and a small barium filling at the bottom.

The six-hour examination shows no residue and no evidence of hypersecretion in the stomach. The gas bubble in the cardia is pear shaped and perfectly smooth in outline. Again in this picture there is at the upper and medial side of the gas bubble of the cardia a second and smaller gas bubble with a fluid level and a small amount of barium at the bottom.

At this time the stomach was filled a second time with a barium suspension mixture. There was no cardiospasm, no spasm along the greater curvature of the stomach and not the least tenderness in the epigastrium. Examination of the patient in the upright position yielded no additional information. In the supine position the fundus of the stomach showed a perfectly smooth outline. There was no pathology seen in the posteroanterior view. However, the semilateral view, with the right side of the patient toward the screen, showed a barium-filled recessus behind the cardia of the stomach just below the dome of the left diaphragm and below and behind the esophageal junction. This pouch was 4.0 cm. in length and 2.5 cm. in width, and connected with the stomach by a barium-filled neck which was 1.5 cm. in diameter. It was positively separated from the esophagus. The outline was perfectly smooth and the density of the shadow uniform. Again I wish to emphasize that there was not the slightest tenderness on palpation.

The twenty-four hour examination showed an atonic colon. The appendix was not visualized but the tip of the cecum was markedly tender on palpation. The stomach still showed a small barium residue in the region of the fundus corresponding to that seen in the previous examinations.

Roentgen Diagnosis: Enteroptosis—appendicial irritation. Diverticulum on the posterior wall of the cardia of the stomach.

I regret to state that the diagnosis of diverticulum of the stomach could not be confirmed at the operation undertaken for the removal of the appendix, which proved to be definitely diseased. The patient would not give us permission to remove the appendix through a midline incision which would allow the surgeon

FIG. 1. Stomach filled. Patient in upright position. Second gas bubble with a fluid level and barium filling seen at the medial and upper part of the gas bubble in the fundus of the stomach.

FIG. 2. Six-hour examination. Patient in upright position. Long pear-shaped gas bubble in the fundus. Second gas bubble with barium and fluid level in the upper and medial part.

to palpate the stomach. She insisted upon a small incision over McBurney's point which did not give the surgeon an opportunity to feel the stomach. Therefore the diagnosis of diverticulum of the stomach must rest on the roentgen findings alone.

FIG. 3. Stomach filled. Patient in supine position, semi-lateral view. Diverticulum of posterior wall of the cardia of stomach, separated from the esophagus.

After operation, the patient presented herself several times for re-examination. The diverticulum is persistent but the patient is relieved of her former complaints of pain in the right lower quadrant and indigestion. Although she knows about the unusual findings we have made in regard to her stomach, the patient has not the slightest abnormal sensation in that region, and therefore we feel that no treatment is indicated.

A true diverticulum is a circumscribed, more or less rounded pocket or bag-shaped protrusion from the lumen of the stomach, containing all three layers of the viscus (Kaufmann[23]). In the roentgen picture it appears as a persistent, rounded, smoothly outlined, movable and insensitive pocket with no infiltration, no retraction and no opposite spasm, usually situated on the posterior wall of the cardia of the stomach and presenting a gas bubble with a fluid level when examined with the patient in the upright position (Akerlund[1]). In the false diverticula, one or more layers of the wall are missing, most often the muscular (Weiss[19]). Such a case has been described as hernia mucosa by Emery,[7] and is nothing but a protrusion of the mucous membrane through a tear in the muscular coat. Haudek's[17] niche cannot be considered a diverticulum (Borszéky[3]) although the roentgen picture may be quite the same.

The ulcer history together with spasms and tenderness on palpation serves to establish the correct diagnosis. de Quervain[38] once saw a case in which he observed during the roentgen examination several small protrusions from the gastric wall. At operation they proved to be circumscribed spastic contractions of the wall of the stomach, simulating diverticula, but they were not persistent. Falconer,[5] Weichselbaum,[18] Klob,[28] Wagner,[17] Gegenbauer,[11] and Nauwerck[35] described true diverticula of the stomach, which contained, in addition to the three layers of the stomach wall, pancreatic tissue, even though the diverticula were not adherent to the pancreas.

The oldest communication concerning a diverticulum of the stomach was by Helmont[18] in 1804. During the following century only a few cases, discovered accidentally at post mortem, were reported. The majority of the known cases have been detected more recently by the help of the roentgen ray. Most of the diverticula of the stomach have been found in the cardiac region, fewer in the pars media and at the pylorus. In some cases the suspected diverticulum proved to be an ulcer at operation. In 2 cases (Mayo,[32] Mellon[33]) a carcinoma was found at the bottom of the diverticulum.

As to their etiology, we may distinguish congenital and acquired diverticula of the stomach. The latter again may be subdivided into pulsion and traction diverticula.

The fundus of the human stomach develops as a pouch on the outer side of the cardia. In the congenital formation of a diverticulum another and smaller pouch develops at a certain point on the gastric wall and remains connected with the stomach by a narrow neck. In mammals of the pig family, diverticula are very often found at the cardiac end of the stomach and are not to be considered pathological (Keith,[26] Mayo[32]). Hurst and Briggs[22] think, therefore, that all true diverticula are congenital in origin. But if this statement and the conclusions are right, all true diverticula should be found only in the cardiac region. However, we know of true diverticula in the pyloric region, found at post mortems. As stated before, in many of these cases, pancreatic tissue has been found at the bottom of the diverticulum although there was no connection found between the diverticulum and the pancreas. According to Glinski[12] we must look upon these diverticula as caused by a developmental disturbance, which has misplaced an accessory pancreas either in the gastric or intestinal wall, thus causing the formation of a diverticulum, although the mechanism of its development cannot be explained by this last statement.

In order to try to explain the genesis of the pulsion diverticula, we have also to consider their anatomical location. If we remember the normal anatomy of the stomach, we know that the longitudinal muscle fibers divide at the dorsal wall of the cardiac region into two main courses. One spreads over the fundus and goes to the greater curvature, the other follows the lesser curvature (Merkel,[31] Fleischner[9]). The circular fibers are thick and abundant at the pylorus, they spread and thin out as the cardia is approached. The oblique fibers are likewise thin at the cardia. In addition to this structural weakness of the cardia, greater blood vessels enter the stomach walls at this point, thus producing another deficiency in the muscular coat (Hirsch[21]). All these factors work together to form at the posterior wall of the cardia a locus minoris resistentiae, just as there is at the posterior wall of the pharynx, where Zenker's esophageal diverticulum always appears at a certain spot, which shows anatomically the same structural weakness. Thorel[45] and Zahn[50] furthermore point out that this region of the stomach is always under a greater strain than other portions, with exception of the pylorus, because food entering the stomach always passes along this course, which is therefore called the "Magenstrasse." Any increased intragastric pressure may therefore lead to a propulsion of the gastric wall at this spot. As to the strict classification of these diverticula, it may be difficult to say, after this consideration, whether they may be considered as true or false diverticula, because from the mechanism of their formation they are nothing but herniae (Brown[4]). Certain observations support this state-

ment. Thomson[11] reports such a case, where all coats were present but thin. In Hirsch's[21] case, the muscularis was missing; the same finding was made in Handtmann's[15] case. Zahn[30] reports another case, which illustrates this theory: a trauma caused small ruptures of the muscularis of the stomach, thus forming small gastric herniae resembling diverticula. A case of true pulsion diverticulum of the stomach, caused by the pressure of a trichobezoar, is reported by Schulten.[41] Borszeky's,[3] Freedman's[10] and Petren and Elding's[37] cases are penetrating or perforating ulcers, simulating diverticula.

Another cause for the formation of a pulsion diverticulum may be stenosis of the pylorus, where the increased intragastric pressure causes a protrusion of the stomach wall at a "weak spot." The reason why the particular spot is a weak one usually cannot be explained (Kleine,[27] Grassberger[13]). On the other hand, there are cases known where a diverticulum near the pylorus was found without pyloric stenosis and the diverticulum contained all three layers of the gastric wall intact with no pancreatic tissue. The etiology of such a case cannot be explained (Tupper[46]).

The causes for the genesis of a traction diverticulum of the stomach are more evident. There are cases described in which inflammation of the gall-bladder (Tilger[43]) and of the pancreas (Heubel,[20] Kolaczek[30]) caused adhesions with the gastric wall which, by shrinking and subsequent pulling, resulted in the formation of a traction diverticulum. Jones[23] describes a diverticulum, found at operation, lying in the midst of adhesions between stomach, transverse colon and ligamentum gastrocolicum, probably caused by an old ulcer, which was, however, completely healed. Chutro[9] reports another big diverticulum on the anterior wall of the stomach, probably caused by adhesions of this part of the stomach with the abdominal walls, where a hernia had formed. Whenever the intraabdominal pressure increased, part of the stomach wall was drawn into the hernial sac, thus forming a traction diverticulum. Even extragastric tumors may cause a diverticulum by traction of adhesions, as seen in the case of Hansemann.[16] Béclère's[2] diverticulum, complicating a case of peptic ulcer after gastroenterostomy, may also have had its origin in traction from postoperative adhesions. Another cause for diverticulum formation is the traction of shrinking glands, first mentioned in the genesis of the diverticula of the esophagus by Zenker. An upper lumbar gland, inflamed for some reason, may form adhesions with the posterior wall of the stomach. After the inflammatory process has subsided, the gland shrinks and pulls on the adherent gastric wall, thus leading to the formation of a diverticulum (Heubel,[20] Nauwerck,[33] Thorel[45]).

Some of the reported cases of diverticula of the stomach were just casual findings and presented no symptoms referable to this abnormality. Akerlund's,[1] Rothbart's,[40] and Gray's[14] cases, and the case described by the author belong in this category. It may be that this is a proof of their congenital origin. In Lawson's[31] case, where a diverticulum of the stomach was found in addition to chronic cholecystitis and cholelithiasis, the symptoms of the patient disappeared after the removal of the gall-bladder, while the diverticulum was not touched. Emery does not believe that there are characteristic symptoms, in spite of the fact that many patients, in whom diverticula are found, present approximately the same symptom complex. Tupper,[46] Weiss,[49] Mellon,[32] Brown,[4] Pearlstein,[36] Jordan,[24] Thomson,[11] Carman,[5] and Emery[7] himself, report a burning sensation or pain in the epigastrium and feeling of fullness or even pressure after eating. In some of the cases, vomiting afforded relief. In Mayo's[32] case, the symptoms were quite irregular.

To make a preoperative diagnosis, everything depends therefore upon the roentgen examination. In this work, not enough emphasis can be laid upon a careful roentgenoscopic examination, both in the upright and supine positions, and especially in both oblique views, because a straight anteroposterior or posteroanterior view may not reveal a diverticulum, which is situated on the posterior wall of the stomach. A diverticulum at the pylorus or on the lesser or greater curvatures will be more readily observed, whereas an addi-

tional gas bubble at the fundus region may be overlooked, if the patient is examined in the upright position only. If it happens that there is a diverticulum on the posterior wall of the cardia, it will show plainly only if the patient is examined in the oblique view while in supine position. If roentgenography is used without roentgenoscopy, a peristaltic wave may be diagnosed as a diverticulum. Roentgenoscopy will show us immediately whether or not the abnormality is persistent. A protrusion from the gastric wall at any place accompanied by a spasm at the opposite side and tenderness on palpation is certainly not a diverticulum but a penetrating or perforating ulcer, and the ulcer history of the patient will tell the rest of the story.

Coming to the treatment, Emery's opinion is that if the symptoms of a patient, who has a diverticulum as proven by the roentgen film and roentgenoscopy, can be explained by other pathology than the diverticulum, nothing should be done about the latter. However, it should be kept in mind that the continued irritation from food retention in such pockets may be considered a potential factor for the development of cancer. The reports of the finding of a cancer at the bottom of a diverticulum by Mayo[32] and Mellon[33] may therefore suggest the removal of every diverticulum. Considering, however, that there are only 2 such cases known, we have not enough evidence to warrant any definite conclusions, and that is why no definite rules for the treatment, at least of the congenital, symptomless diverticulum, can be laid down. Needless to say, a traction diverticulum caused by adhesions of any kind, should be operated upon, especially if it produces unfavorable symptoms.

SUMMARY

A case of diverticulum of the posterior wall of the stomach near the cardia is reported. It produced no gastric or other clinical symptoms and is therefore supposed to be congenital.

The diagnosis was made by roentgen examination alone.

Due to the uncertainty of clinical symptoms, the preoperative diagnosis of diverticula of the stomach rests upon the roentgen examination. Stress is laid upon the roentgenoscopic examination in the upright and supine positions and especially in the oblique views.

A review of the accessible literature with an attempt to explain the etiology of diverticula of the stomach is given.

Decision as to treatment depends upon the symptoms. No definite rules can be laid down. It should, however, be kept in mind that every diverticulum is potentially liable to the development of cancer.

REFERENCES

1. AKERLUND, AKE. Diverticula of the stomach from a roentgenological point of view. *Acta radiol.*, 1923, ii, 476–485.
2. BÉCLÈRE, HENRI. Ulcus peptique et diverticule (controle opératoire) sur bouche de gastro-entérostomie pour ulcère juxta-pylorique. *J. de radiol. et d'électrol.*, 1923, vii, 161–163.
3. BORSZÉKY, K. Divertikelbildung am Magen durch peptisches Geschwür. *Zentralbl. f. Chir.*, 1914, xli, 969–971.
4. BROWN, GEORGE, E. An unusual stomach case with roentgenographic findings. *J. Am. M. Ass.*, 1916, lxvi, 1918–1919.
5. CARMAN, R. D. Roentgen Diagnosis of Diseases of the Alimentary Canal. Second edition. W. B. Saunders Co., Philadelphia, 1921, pp. 354–368.
6. CHUTRO, PEDRO. Sobre una curiosa deformation del estomacho. *Rev. Soc. med. argent.*, 1909, 382.
7. EMERY, E. S., JR. Diverticula of the stomach. AM. J. ROENTGENOL. & RAD. THERAPY, 1924, xi, 354–358.
8. FALCONER, A. W. A case of congenital diverticulum of the stomach and duodenum in a physiological hour-glass stomach. *Lancet*, 1907, i, 1206.
9. FLEISCHNER, FELIX. Das Kardianahe Magendivertikel. *Klin. Wchnschr.*, 1924, iii, 1619–1621.
10. FREEDMAN, E. Perforated ulcer simulating diverticulum of the stomach. AM. J. ROENTGENOL. & RAD. THERAPY, 1927, xviii, 47–51.
11. GEGENBAUER. Cited by Falconer.
12. GLIŃSKI, L. K. Zur Kenntniss des Nebenpankreas und verwandter Zustände. *Virchow's Arch. f. Path. Anat.*, 1901, clxiv, 132–146.
13. GRASSBERGER, R. Ein Fall von multipler Divertikelbildung des Darmtractes, complicirt mit peptischem Geschwür am Pylorus. *Wien. klin. Wchnschr.*, 1897, x, 149–151.
14. GRAY, I. Diverticulum of stomach: Accidental finding in routine examination. AM. J. ROENTGENOL. & RAD. THERAPY, 1925, xiv, 110–113.
15. HANDTMANN, E. Zur Kenntnis der Divertikel des Magens. *Inaug. Diss.*, Jena, 1912.
16. VON HANSEMANN, F. Magendivertikel. *Verhandl. d. Gesellsch. deutsch. Naturf. u. Aerzte*, 1895, 514.
17. HAUDEK, M. Die Röntgendiagnose des kallösen (penetrierenden) Magengeschwürs und ihre Bedeutung. *München. med. Wchnschr.*, 1910, lvii, 2463–2467.
18. HELMONT. Cited by Voigtel. Handbuch der path. Anatomie, 1804, p. 512.
19. HENKE-LUBARSCH. Handbuch der path. Anatomie, iv, i, 198. Julius Springer, Berlin, 1926.

20. Heubel, H. Ueber ein mit dem Ductus Wirsungianus communicirendes Tractionsdivertikel des Magens. *Deutsches Arch. f. klin. Med., lv Festschr. ... für F. A. von Zenker (etc.), Leipz.*, 1895, 240–254.
21. Hirsch, E. Uber ein Magendivertikel. *Virchow's Arch. f. path. Anat.*, 1903, clxxiv, 576–579.
22. Hurst, A. F., and Briggs, P. J. Diverticula of the stomach; a possible source of error in the radiological diagnosis of gastric ulcer. *Brit. J. Radiol.*, 1925, xxx, 1–4.
23. Jones, A. A. A case of diverticulum at the pylorus. *J. Am. M. Ass.*, 1909, liii, 1397.
24. Jordan, S. M., and Lahey, F. H. Diverticula of the alimentary tract. *S. Clin. N. Am.*, 1926, vi, 747–765.
25. Kaufmann, E. Lehrbuch der path. Anatomie, i, p. 562, Berlin, 1922, Verein wissenschaftl. Verleger.
26. Keith, Arthur. A demonstration of diverticula of the alimentary tract of congenital or of obscure origin. *Brit. M. J.*, 1910, i, 376–380.
27. Kleine, W. Ueber Blindsackbildung im Magen. *Inaug. Diss.* Goettingen, 1895.
28. Klob. Cited by Falconer.
29. Van Könitzey, E. Erworbenes Pseudodivertikel des Magens. *Zentralbl. f. Chir.*, 1926, liii, 2265–2267.
30. Kolaczek, M. Magendivertikel und Pankreasgewebe. 73. *Jahresb. der schles. Ges. f. vaterl. Kultur Abt. V. Medizin.* 1895–96, pp. 71–73.
31. Lawson, J. D. Report of a case of gastric diverticulum. *Radiology*, vi, 518–520.
32. Mayo, C. H. Diverticula of the gastro-intestinal tract. *J. Am. M. Ass.*, 1912, lix, 260–264.
33. Mellon, R. R., and others. The incidence of carcinoma in gastro-intestinal diverticulosis. *Surg., Gynec. & Obst.*, 1921, xxxiii, 177–182.
34. Merkel, J. Anatomie des Menschen, iv, 184. J. F. Bergmann, Wiesbaden, 1925.
35. Nauwerck, C. Zur Kenntniss der Divertikel des Magens. *Deutsche med. Wchnschr.*, 1920, xlvi, 119–121.
36. Pearlstein, F. Diverticulum of the cardia of the stomach. *Med. J. & Rec.*, 1926, cxxiv, 134–136.
37. Petren, K., and Elding, L. Eine bisher nicht beschriebene Form des sog. Nischensymptoms beim Ulcus Ventriculi. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1913, xxi, 45–47.
38. de Quervain, F. Ueber Divertikelbildung am Magen, insbesondere über funktionelle Divertikel. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1915, xxviii, 690–708.
39. Ravenel, L. J. Diverticulum from the anterior surface of the stomach near the cardio-esophageal junction. Am. J. Roentgenol. & Rad. Therapy, 1923, x, 904.
40. Rothbart, L. Echtes Magendivertikel. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxx, 563–565.
41. Schulten, M. W. Ueber Haargeschwülste im Magen nebst Mitteilung eines glücklich operierten Falles. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1897, ii, 289–303.
42. Sutherland, C. G. Multiple diverticula, with hemorrhage, in the wall of the stomach: Report of case. *Radiology*, 1925, v, 523–524.
43. Tilger, A. Ueber einen Fall von Traktionsdivertikel der Pylorusregion des Magens durch Gallenblasenverlagerung. *Virchow's Arch. f. path. Anat.*, 1893, cxxxiii, 201–206.
44. Thomson, J. W. Diverticulum of stomach. *Brit. J. Surg.*, 1926, xiv, 180–181.
45. Thorel, F. Magendivertikel. *Sitzungsb. d. aerztl. Ver. Nürnb.*, 1895, p. 57.
46. Tupper, E. E. Diverticulum of the stomach. *Wisconsin M. J.*, 1923, xxi, 442–446.
47. Wagner. Cited by Falconer.
48. Weichselbaum. Cited by Falconer.
49. Weiss, Samuel. Diverticula of stomach. *Med. J. & Rec. (Supp.)*, 1925, cxxi, 768–770.
50. Zahn, Georg. Ein Beitrag zur pathologischen Anatomie der Magensdivertikel. *Deutsches Arch. f. klin. Med.*, 1899, lxiii, 359.
51. Enfield, Charles D. Radiography. P. Blakiston's Son & Co., Philadelphia, 1925, p. 184.

DIVERTICULUM OF THE STOMACH

BY BENJAMIN M. BERNSTEIN, M.D.

Jewish Hospital

BROOKLYN, NEW YORK

IN going through the literature, one is struck with the comparatively few cases of diverticulum of the stomach reported compared with those of the esophagus or other portion of the digestive tract. It is because of this infrequency, as well as the clinical significance of this abnormality, that I take the opportunity of reporting this case in more or less detail.

CASE REPORT

H. T. G., aged thirty-four, referred for gastrointestinal study, gave a history of abdominal complaints dating back for about six months prior to consultation. She described attacks of severe pain posteriorly in the lower dorsal region on the right side radiating through to the right hypochondrium and epigastrium. This pain came on at irregular intervals and always at night waking the patient from sleep. The attacks were always accompanied by nausea and vomiting. At no time were there any fever or chills. Patient never became jaundiced, had no belching, eructations or heartburn during or between these attacks. There were no other complaints of any kind.

Physical examination of the patient showed a well-nourished female who had just gotten over one of these attacks and whose only finding was marked tenderness in upper right abdomen anteriorly suggesting the possibility of some gall-bladder lesion.

Roentgen-ray study showed a normal cholecystogram after two attempts at visualization by the oral method with the dye in emulsion form. The barium meal was then given; this revealed the presence of a pocket on the lesser curvature of the stomach about one inch below the cardia, separate and distinct from the outline of the stomach itself, and showed a variable degree of filling on numerous films made. The barium in this pocket was retained for a period of about ninety-six hours during which the patient was observed.

The appearance of this pocket, simulating perforating ulcer, but really that of a diverticulum, fulfills the criteria for a diagnosis of this condition as set down by Akerlund,[1] namely: variation in completeness of filling, roundness and smoothness of contour and absence of inflammation around it. The location of this diverticulum corresponds to that seen by most observers who have described such cases in the literature, in that it springs from the lesser curvature just below the cardia, though a few have been found near the pylorus and greater curvature. Because of this fact, Fleischner[2] has called these "kardianahe" diverticula. Various observers have attempted to explain the reason for the frequency of diverticula in this region, that is, near the cardia, by the weakness of the musculature at this point. However, this theory would not explain its appearance on the lesser, rather than on the greater curvature, anterior or posterior wall. We must, therefore, content ourselves with the fact rather than the reason for their being found here, and not elsewhere on the gastric wall. It seems a bit strange perhaps, that diverticula of the esophagus and duodenum are likewise most frequently seen in the proximal portion of these organs, for example, in the upper portion of the esophagus and in the first portion of the duodenum. Diverticulosis of the colon does not follow this rule inasmuch as it is most frequently found in the distal or sigmoid colon, and rarely in the cecum or proximal portion.

Diverticulum of the stomach has been found incidentally at the autopsy table by Zahn, Thorel, and Handtmann, the latter also having found one on the greater curvature below the cardia. These diverticula are pulsion rather than traction in origin, though Zahn has reported one case in which he found adhesions between the base of the diverticulum and the diaphragm suggesting traction as a possible cause in this particular case. It is interesting to note that most of the cases reported have been found in the female, the reason for which I have neither explanation nor theory.

The relationship of the presence of diverticulum of the stomach to the produc-

tion of gastric symptoms is of the greatest clinical interest and importance, particularly inasmuch as the appearance of these diverticula may very well be confounded with perforating ulcer. Brown reported a case in which there was a history of hematemesis, leading him to believe that he was dealing with a case of ulcer but found a diverticulum on surgical exploration. Emery also reported 2 cases with definite states that diverticula of the stomach are found rather frequently in many animals and frequently in association with pancreatic rests, a fact whose significance can scarcely be estimated.

Gray[7] reported a similar case with some detail in 1925. Hurst and Briggs[6] likewise discussed the subject in a paper published in 1924.

We must leave in abeyance the question

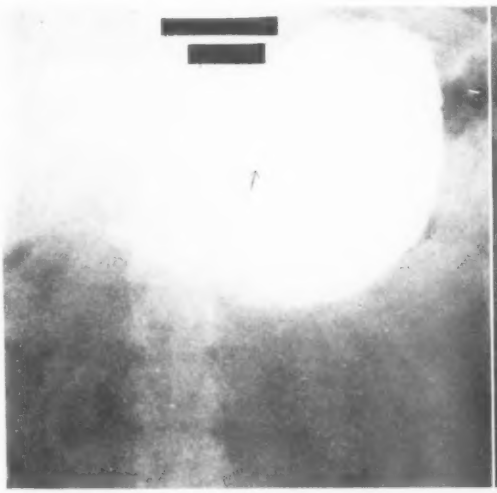

FIG. 1. Taken immediately after ingestion of opaque meal.

FIG. 2. Seventy-five hours after ingestion of opaque meal.

gastric symptoms. Jonas[3] had such a case under his observation for a number of years and believed the patient's symptoms to be the result of the diverticulum. Incidentally, in 1926, in a review of the literature, Brown quoted only 38 cases of diverticulum in any portion of the stomach.

Much has been said in the literature, particularly by Cleve[1] of the significance of the finding of rests of pancreatic tissue at the base of some of these diverticula. This finding would suggest that the diverticulum is a developmental irregularity, a theoretical standpoint which is probably the best answer we can give, in the light of our present knowledge, for this abnormality. However, pancreatic tissue has not been found sufficiently often to establish a definite connection between this fact and the causation of diverticula. The infrequency of the finding of diverticula, in general, makes it difficult to prove or disprove any theory propounded. Fleischner of therapy of this condition until we have seen a sufficient number of cases to determine the relationship between this abnormality and the clinical history. However, if a definite connection between the two can be established, then the surgical procedure of a perforating ulcer must be our method for relief.

To summarize: Diverticulum of the stomach is a rather infrequent finding, usually incidental, in the course of a roentgen-ray study of the gastrointestinal tract. Its ability to produce symptoms strongly suggestive of penetrating ulcer of the posterior wall, must always be taken into consideration and treatment advised accordingly.

REFERENCES

1. AKERLUND, AKE. Diverticula of the stomach from a roentgenological point of view. *Acta radiol.*, 1923, ii, 476–485.
2. FLEISCHNER, FELIX. Das Kardianahe Magendivertikel. *Klin. Wchnschr.*, 1924, iii, 1619–1621.
3. JONAS, SIEGFRIED. Über das sogenannte angeborene

Divertikel der Kardia. *Wien. med. Wchnschr.*, 1926, lxxvi, 1062–1067.
4. CLEVE, A. Divertikel und Divertikelmyome des Magens. *Virchow's Arch. f. path. Anat.*, 1925, cclv, 373–383.
5. GRAY, I. Diverticulum of stomach: Accidental finding in routine examination. AM. J. ROENTGENOL. & RAD. THERAPY, 1925, xiv, 110–113.
6. HURST, A. F., and BRIGGS, P. J. Diverticula of stomach, possible source of error in radiological diagnosis of gastric ulcer. *Guy's Hosp. Rep.*, 1924, lxxiv, 432–439.
7. LAWSON, JOHN D. Report of a case of gastric diverticulum. *Radiology*, 1926, vi, 518–520.
8. PEARLSTEIN, F. Diverticulum of the cardia of the stomach. *Med. J. & Rec.*, 1926, cxxiv, 134–136.

RETROGRADE INTUBATION OF THE CECUM*

BY HOWARD CROSBY HOFF, M.D.

NEW YORK CITY

COMPLETE retrograde intubation of the large intestines is a new enough procedure to warrant a paper on its technical aspects. One feels some hesitancy in presenting this subject because of the unsavory commercialism which is attached to the "high colonic irrigation fad." In the following, I shall indicate how to assemble a satisfactory outfit from the armamentarium of an average physician, describe the technique to be used and, lastly, take up the accomplished fact in relation to its practical usage.

An ordinary metal office table with a broad drip pan and a large bucket for catching the return flow disposes of the table problem. A glass reservoir of at least 4 quart capacity, preferably on a stand, is another requisite. Naturally a stool will be found a convenience. The operator will do well to protect himself with a gown and a long rubber apron against any sudden deluge and he will want to wear surgeon's rubber gloves.

The type of tube used is of great importance. I prefer one about 60 inches long with an outside diameter of ½ inch. The penetrating end should be blind with the openings placed on the sides, as this arrangement takes advantage of the propelling force of any fluid passing up the tube. The first 3 or 4 inches below the tip should be especially soft and pliable in order to obviate any danger of perforation and so that sharp turns can be negotiated. The next 30 inches must still be pliable but of a somewhat firmer tone as it is very difficult to advance a tube that is soft throughout its entirety. The final part of the tube can be even still firmer as it traverses only the lower bowel and has no very sharp twists to circumvent. Now how can all of these factors be obtained? My method is to take an ordinary Lockwood colon tube which comes of the right diameter and from 34 to 36 inches in length and attach it to a piece of rubber hose of like diameter but of a little firmer consistency, by means of a small aluminum nipple which I had a metal worker make for me. Thus I was enabled to get the proper length and resiliency for the main part of the tube. The tip was a little too firm so I punched parallel rows of holes down its sides for several inches thus weakening the rubber and producing the desired effect. After a colonic tube so constructed has been boiled several times it becomes ideal for the purpose at hand.

The assembly of parts between the irrigation tank and the colon tube is as follows: From the former a 5 foot tube controlled by a clamp leads to one of the horizontal arms of a glass T-tube. From the other horizontal arm a piece of hose connects directly with the colon tube by means of a stopcock. This connecting piece of hose can, with advantage, be split at its middle and the two parts united by a sleeve connection which permits the colon tube to be twisted on its long axis without knotting up all the rest of the tubing. To the vertical arm of the glass T-tube a piece of hose is attached with a stopcock

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

FIG. 1. Retrograde cecal intubation in an approximately normal colon.

FIG. 2. Same case as Figure 1, with barium injected through the tube filling the proximal colon.

FIG. 3. Retrograde cecal intubation with redundant pelvic colon and low transverse colon.

FIG. 4. Same case as Figure 3, with barium filling of proximal colon.

at its free end. Thus a lateral vent to the main line is supplied which by properly setting the cutoffs can be used for a return flow, a collateral line for injection and by attaching a rubber bulb an improvised pressure gauge.

Unless contraindicated, the patient is told to take a cathartic the night before

FIG. 5. Retrograde cecal intubation with sharp kink of iliac colon and partial reverse splenic flexure.

FIG. 6. Same case as Figure 5, with barium filling of proximal colon.

FIG. 7. Retrograde cecal intubation with sharp iliac kink and short, fairly high cecum.

FIG. 8. Same case as Figure 7, with barium filling proximal colon.

the tube is to be passed and to take an ordinary enema just before coming for treatment. This removes what might be called the floating bowel content and makes the task of the operator easier and less objectionable. The patient should urinate before the tube is passed so that the desire to do so may not become urgent as soon as the kidneys are stimulated to activity by the rapid absorption of fluid from the bowel, and also to obviate the pressure of a distended bladder on the

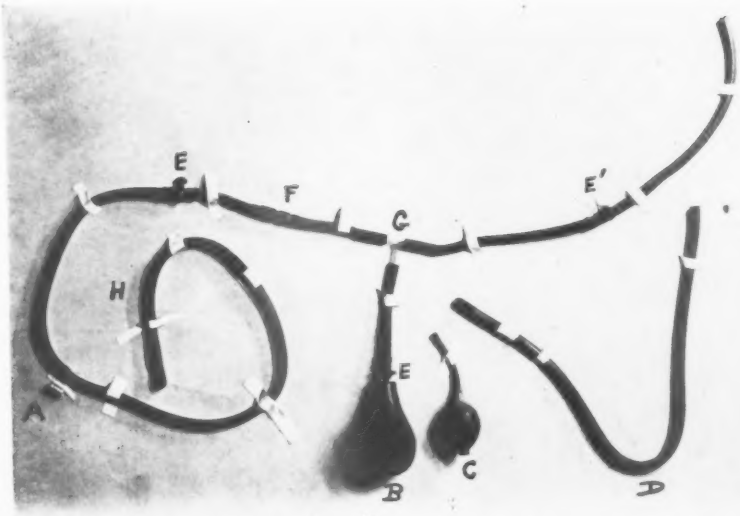

Fig. 9. Apparatus for retrograde cecal intubation. A. Short aluminum connecting nipple used in making connection between Lockwood colon tube and extension hose. B. Eight ounce bulb for aspiration and injection of fluid; also acts as a gauge of pressure in colon tube. C. Bulb of de Vilbiss syringe for an injection. D. Accessory rectal tube for emptying lower colon. E, E. Stopcocks. E'. Cutoff. F. Sleeve valve. G. Glass T-tube.

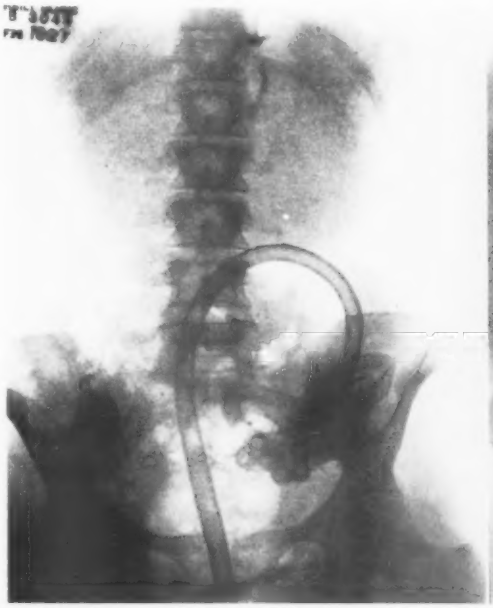

Fig. 10. Failure of cecal intubation due to coiling of tube in pelvic colon (common error).

Fig. 11. Failure of cecal intubation due to the use of too stiff a tube causing dangerous pressure at splenic flexure.

rectum. As a routine measure, the procedure is started with the patient in the left Sims' position so as to favor the straightening out of the rectosigmoidal kink. The anal orifice is well greased with vaseline or a similar non-water soluble lubricant. The water soluble lubricants are inappropriate as they are soon washed off and the sphincters are enabled to grip the tube in a way to seriously embarrass the operator and to cause considerable discomfort. The irrigator should not be more than 18 inches above the patient and as a preliminary to introducing the tube all air should be driven from it, the connections,

FIG. 12. Failure of cecal intubation in a case of sharp iliac kink. Tube stopped at mid-transverse colon.

FIG. 13. Failure of cecal intubation in a case with subhepatic fixation of pelvic colon. Tube tip coiled in distal transverse colon.

FIG. 14. Failure of cecal intubation in a case of redundant pelvic colon. Tube reversed at mid-transverse colon due to obstruction from spine.

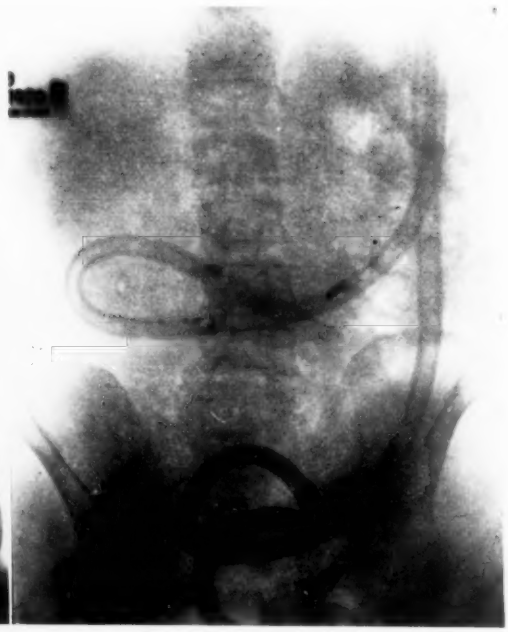

FIG. 15. Failure of cecal intubation. Tube reversed at hepatic flexure.

etc., by allowing them to become filled with the solution to be used. The return flow is usually passed off through a rectal tube inserted into the rectum beside the colonic tube and draining into the drip pan underneath the table.

It is practically impossible to do more than give certain hints about the actual maneuvers required to insert a tube as they vary with every case. It always helps to have a roentgenogram of a barium enema to serve as a chart for the location and character of the obstructions to be overcome by the tube. The finger in the rectum is the best guide for the tube through the first part of its course as it recognizes when it meets with obstruction and can sometimes help release it. I have discarded the proctoscope as a means of introducing the tube as being less efficacious than the method indicated. In the beginning, the tube advances behind a water column which opens up the coils ahead of it. Later fluid returning from the higher part of the bowel may cause enough distention to permit of an advance against the flow while the colon is being drained for a fresh start. Two general types of patient are encountered. There are those who readily hold a large quantity of fluid and those who do not. In the first instance the loops will become widely distended and curling up of the tube within them will be the usual difficulty. In the second, the tube may not be sufficiently freed from contact with the intestinal wall or the kinks opened up enough to permit its passage. Here is where not only regulating the quantity but also changing the temperature may solve the difficulty. The warmer solutions (105–110° F. in the tank) relieve spasm but promote peristalsis. This double action may prove a handicap, yet, fortunately, in the spastic cases the chief action is to control the spasm and in the atonic cases to set up a peristalsis that increases the tone of the intestinal muscles without usually developing force enough to expel the tube. Temperatures around 92–94° F. in the tank have least effect on the bowel. The colder temperatures tend to inhibit peristalsis and paralyze the gut. In rare cases, it may be necessary to resort to the assistance of drugs. The

FIG. 16. Failure of cecal intubation. Tube stopped at hepatic flexure with resultant anterior bellying of transverse colon, easily perceived clinically but only partially shown in film.

position of the patient is of great help if properly ordered. Right and left Sims', back, knee-chest, upright and even Trendelenburg positions in various sequences may be found advantageous. There is no sure test that the tip of the tube is in the cecum except by roentgen examination. A little hint may be gained, however, that the task has been accomplished when the patient after the tube is well in suddenly seems unable to hold as much fluid as previously. This phenomenon is due to the fact that the cecum and ascending colon are physiologically more or less closed off from the rest of the large bowel and fill up rapidly. The trouble is that a coiled up tube may induce a spasm in some other section of the colon with results closely simulating this manifestation. Due to the fact that the cecum, sigmoid and transverse colon frequently lie in juxtaposition, any attempt to apply the methods of physical diagnosis to locating the tube will prove inaccurate. As in everything else, however, there comes with practice and experience an intuitive sense that guides one past the pitfalls that trap the less

instructed but this has to be acquired and cannot be taught. One last warning must be given, however, that it is both useless and dangerous to force the tube as it will surely buckle or turn on itself and might perforate the intestine.

While I am not ready to elaborate on the therapeutic application of retrograde intubation of the colon, it may not be amiss to indicate results that my experiences with the procedure seem to predicate.

1. It carries out the purposes of an enema more thoroughly and in closer conformity to normal physiological standards than any other method and so finds its greatest use in unloading the bowel in cases of right-sided colonic stasis. It will surprise anyone who has not seen the method in operation before to note how much effete material it will bring away after all that can be accomplished by cathartics and ordinary douches has been tried. From what has just been said it can be inferred that it is an efficient means of controlling toxic absorption from the cecal region.

2. A second fundamental purpose of the procedure is to exercise the bowel and stimulate it to better function. I know there has been a good deal of criticism of the enema by men whose knowledge was usually theoretical and rarely from first hand experience, that it causes dilatation and atony. They seem to regard the bowel, in effect, as rubber tissue that has just so many good stretches in it, after which it will "go dead," instead of realizing that intestinal muscle, like all other muscle, responds to use by increased ability to function, to misuse by laming and to disuse by atrophy. A series of properly given enemas will improve the tonicity and peristaltic activity of the colon, and where results are not satisfactory the skill and judgment of the operator are as likely to be at fault as the method.

3. By using the bulb attachment, means is afforded for making topical applications anywhere in the large bowel with solutions that are too expensive or unsuited for administration in the large bulk necessary for the usual type of enema. This brings the method in line for the treatment of some types of colitis.

4. It opens up the higher colonic segment for water and drug absorption if the lower segment is found unutilizable. It should be noted that the cecum has a selective absorptive action.

Vol. XX, No. 3

FURTHER OBSERVATIONS ON THE SATURATION METHOD IN ROENTGEN THERAPY AS APPLIED TO DEEP-SEATED MALIGNANT DISEASE*

BY GEORGE E. PFAHLER, M.D.

Professor of Radiology in the Post Graduate Medical School of the University of Pennsylvania

PHILADELPHIA, PENNSYLVANIA

THE "saturation method" in roentgen-therapy consists in the delivery of an erythema dose into the diseased tissue, and then maintaining this effect for a certain time by means of additional smaller doses to correspond to the loss in effect during any given period. The idea was first advanced as a preliminary report by Kingery,[1] in 1920, in connection with his work in skin diseases. No other paper seems to have been written upon this subject. Hazen[2] says, "We have tried this method upon two cases of cutaneous cancer and have found the skin reaction excessive. MacKee,[3] has had the same experience."

Observations upon this method as applied to deep-seated malignant disease were discussed by me[1/2] before the First International Congress of Radiology, London, England, July 1–4, 1925. At that time I also presented the curves for dosage as applied to deep-seated malignant disease when treated by the various types of filtered radiation then and now in common use. I have found no reason for changing these curves, and curves prepared by Weatherwax on the basis of physical measurements are practically the same, in which he calculates the value of the coefficient of absorption of tissue $\mu = 0.140A$. One can, of course, not apply the curve as developed by Kingery to deep-seated disease with the filtered radiation. In this paper it will be necessary for me to review in great part the facts contained in the former paper.

The principle of the "saturation method" as stated by Kingery is as follows:

"The maintenance of the optimum tissue effect must necessarily depend on the rate at which the effects of the rays are lost. Depending on this time rate is the frequency with which exposures may be repeated, and the quantity that may be administered at each exposure. It seems but logical to assume that tissues exposed to roentgen rays, lose that effect in a constant manner. That the greater the concentration of the biochemical products of irradiation, the higher the velocity of loss, would not only seem to follow naturally, but also apparently is borne out by the observations cited below. If this be true, and if we may assume that the rate of loss varies directly as the concentration of some hypothetical decomposition product, then as this concentration decreases, the velocity of loss will become less in direct ratio. Thus, at such a time as this concentration has decreased by one-half, the velocity of loss will have become less by a similar amount, and so on until the residual effect has become negligible. This rate of loss, theoretically, would represent a logarithmic curve and may be so calculated. Such a curve has been established for many chemical and biologic reactions, which we know as 'mass reactions,' and if we may be permitted to draw an analogy, the biochemical change resulting from the absorption of roentgen rays by tissue elements, may follow a similar law. Should such an analogy be approached, the decreasing residual effect in exposed tissues might describe such a curve as above suggested, and might well lend itself to such a method of representation and computation. In other words, if our analogy is correct, the curves of residual effect in exposed tissue should be a logarithmic curve, and with the velocity of recovery in logarithmic functions, and the intervals between exposures in days, as units, we should be able, mathematically, to estimate fairly definitely the residual effect of the rays in the tissues at any given time, and likewise the dosage required, at that time, to return the tissue to the saturation stage."

Kingery has written only this preliminary paper and confined his clinical observations to skin disease. He used unfiltered rays in his treatment of skin diseases. In such cases, and with that quality of rays, the biological effect is assumed to have decreased to a negligible

* Read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

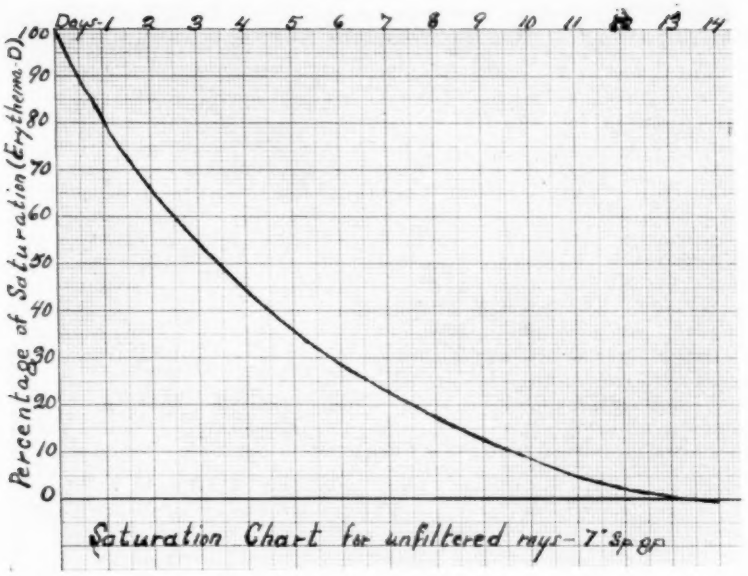
Days-1 2 3 4 5 6 7 8 9 10 11 12 13 14
Percentage of Saturation (Erythema D)
100 90 80 70 60 50 40 30 20 10 0
Saturation Chart for unfiltered rays-7" Sp. gp.

FIG. 1. Saturation curve for use with unfiltered rays, for superficial effects, using rays of a mean wave length of approximately 0.35 Å, 18 cm. spark gap, no filter, in which the interval of time until a full erythema dose can be repeated is approximately fourteen days.

quantity in fourteen days. From clinical observations, it was found that a second erythema dose could be given two weeks after the first erythema dose.

According to this logarithmic curve No. 1 as drawn by Kingery (based on the clinical observation that a 100 per cent dose could be repeated in fourteen days) it may be seen that at the expiration of three and a half days, the residual effect has been reduced to 50 per cent. After a lapse of a similar period, a total of seven days, it has been reduced to 25 per cent. At each of these periods respectively a 50 or 75 per cent dose will bring the biological effect to 100 per cent or to the "saturation" value. Using this type of rays for superficial effect the daily administration of a 25 per cent dose leads, in the course of six days, to 105 per cent, and if further continued would lead to an overdose. Kingery says, "If, however, only 10 per cent is given daily, the curve does not rise above 60 per cent, and one never reaches the optimum or maximum dose."

I urge in the strongest terms possible, however, "*that it must not be assumed from this latter statement by Kingery, that such small doses can be kept up indefinitely or even that the saturation process can be continued indefinitely or very long. This is the great danger from the method. One must always keep in mind the atrophy, endarteritis, and late degenerative processes, or even early necrosis, which are likely to follow overdosage. On the other hand, if the radiation is kept at the saturation point (or as nearly so as the normal tissues will permit) during the brief period of sensitivity of the malignant cells, and while these cells are still undergoing division, it is likely that the disease can be more completely destroyed.*"

In my work, we have been using this saturation method during the past seven years, giving it up only while we were trying out the *single massive dose methods*, which we have now given up except in such cases where the disease is strictly localized and can be safely overdosed.

The saturation curve must, of course, be varied according to the character of radiation used. The length of this curve will depend essentially upon, first, the "erythema dose," or the maximum toleration dose which is indicated by 100 per cent or the top of the curve; and, second, by the interval of time at the end of which such a dose can be safely repeated. The method as applied to skin disease

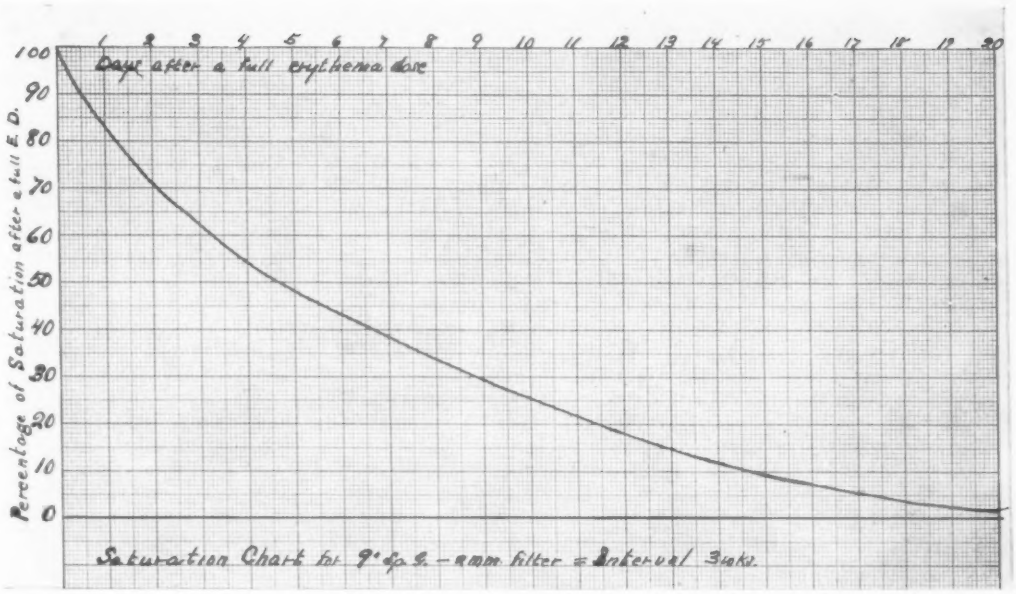
Days after a full erythema dose
Percentage of Saturation after a full E.D.
Saturation Chart for 9" Sp. G. – mm filter = Interval 3 wks.

FIG. 2. Saturation curve for moderately soft rays, using a 9 inch parallel spark gap and 2 mm. Al filter, with a time interval of three weeks.

is, therefore, very simple, as compared with its use in deep-seated malignant disease. The method is essentially more difficult than the single massive dose technique. It requires: (1) the careful measurement of the quality of radiation used; (2) the determination of both the superficial and depth dose; (3) the accurate direction of the beams of rays in cross-firing so as to obtain the maximum effect on the diseased area and the minimum effect on the normal tissue and essential organs; (4) these precautions must be observed in each dose of rays applied, and (5) *the percentage value must be taken into consideration with each dose.* Comparatively few radiotherapists appreciate the importance of attention to all details.

The success of the method depends upon the accuracy and application of all of our physical and biological observations, the development of which has been very well reviewed by Holfelder.[4]

In the consideration of this method we must take into account:

1. The accurate measurement of the radiation as has been taught by Friedrich and Glasser,[5] Duane,[6] and others, where, by means of ionization measurements, the exact dosage can be determined.

2. We must estimate the distribution of the radiation within the tissues in connection with each application, using the information, charts, diagrams, and tables, such as have been prepared by Jüngling,[7] Dessauer and Vierheller,[8] Voltz,[9] Seitz and Wintz,[10] Glocker and others,[11] Holfelder and others,[12] Fricke and Glasser,[13] Gaylord and Stenstroem,[14] Coliez,[15] and others.

3. The cross-firing should be as accurately done as if all the treatment were given at one time. Holfelder[16,17] has not only developed a method whereby this can be done, but has called attention to the dangers of inaccurate cross-firing.

4. The normal tissues and the health of the general organism must be conserved so far as possible. It is this factor that makes the rate of application variable, and the success will depend much upon the clinical judgment of the roentgenologist. In some cases a full erythema dose can be safely delivered through each portal of entry on successive days. Occasionally it may be advisable to deliver 100 per cent of the erythema dose into the tumor tissue (affected area) on the first day of treatment. I believe that it is always desirable to reach this dose as soon as is possible, consistent with the general health

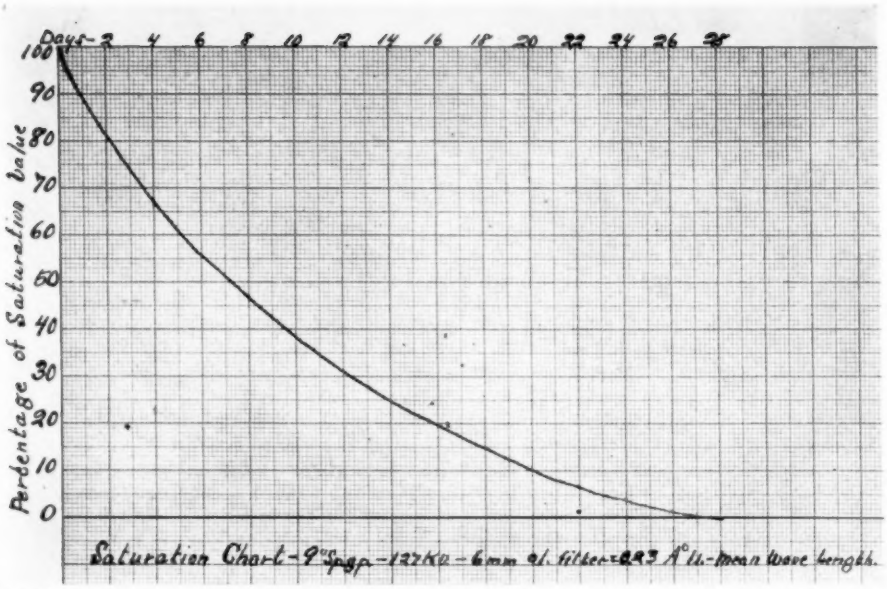

FIG. 3. Saturation curve for use with moderately hard rays having a mean wave length of 0.23 A (23 cm. spark gap, 127 kv., and filtered through 6 mm. Al), and for which the interval between two full erythema doses must be from four to six weeks.

of the patient. Generally, we give 80 per cent of an erythema dose through each portal on successive days.

5. We believe that it is desirable to bring the dose to 100 per cent in the affected part within a few days to a week, and to retain the dosage at or near the saturation point for a period of ten to fourteen days, by means of daily treatments, through each portal of entry successively, but using only such doses as will not exceed the saturation point anywhere in normal tissue. This will then give all of the advantages of the single massive dose, and will continue the effect during the period of cell division as recommended by Regaud, or until all cancer cells are destroyed.

This estimate of the desirable period of saturation given two years ago is, we believe, correct. If after an interval of from one to three months there is remaining evidence of disease or regrowth, some additional treatment may be given, but it must be given with the full understanding that risk is involved. Risk of necrosis or secondary degeneration is justified if it is a matter of life and death and the patient and family are willing to take this risk. It must be borne in mind that the danger of necrosis is especially great when dealing with fatty tissue which is poorly supplied with blood vessels. Localized or small areas especially if well supplied with blood will stand much more radiation than the opposite conditions. It is the failure to keep this fact in mind that in most of the cases has led to necrosis about the abdominal walls and about the buttocks.

All roentgenologists recognize the tremendous assistance that has been given to us by the physicists, but the clinical roentgen therapists also recognize that the treatment of deep-seated malignant disease is not even in greatest part a physical and mechanical problem, but chiefly a biological one. Holzknecht,[18] as a clinician, has especially emphasized this fact, but much experimental work has been done upon inoculated animals, by such men as Caspari,[19] Murphy,[20] Wood and Prime,[21] Keysser,[22] Kok and Vorlaender,[23] and by Russ,[24] which confirms this view.

Most of us are convinced that the chief effect of the radiation depends upon the direct destructive effect of the radiation upon the tumor cells, and that the dose delivered into the diseased area must be

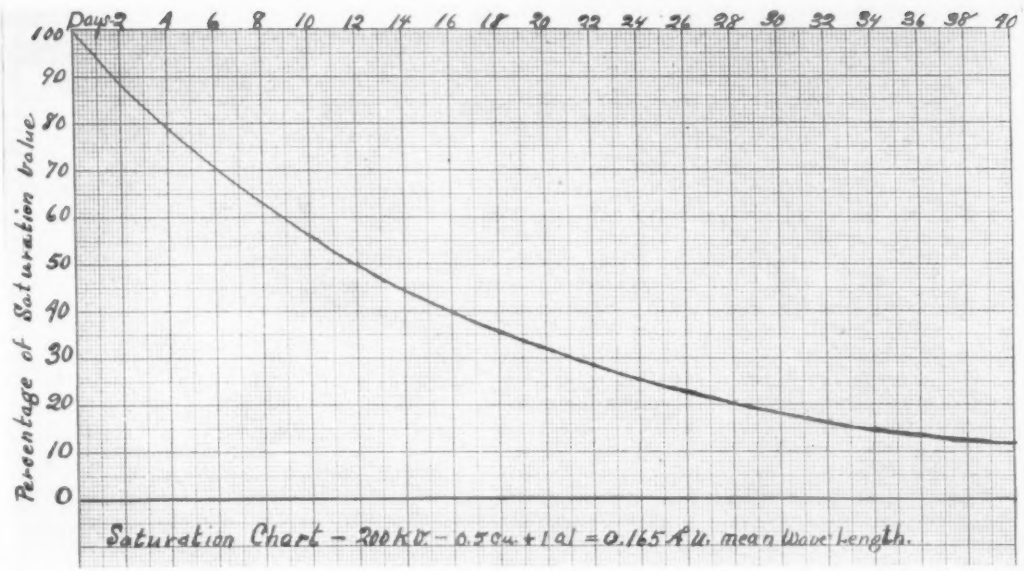

FIG. 4. Saturation curve for use with hard rays having a mean wave length of approximately 0.165 Å (200 kv., 0.5 mm. Cu plus 2 mm. Al), and with which the interval between two full erythema doses must be from eight to twelve weeks.

the equivalent of 1 or greater than an "erythema dose" whether it be called a "carcinoma dose" or not. This dose is probably best indicated in e units as measured by the ionization method.

Jüngling,[25] Holfelder,[1] Seitz and Wintz,[26] Friedrich and Krönig,[27] hold this view. Very few radiologists at present, however, believe that every carcinoma cell can be killed by a single massive dose and if this fortunately occurs it is, in part, due to the defensive powers of the organism, or that various types of tumors according to structure, size, or location present special sensitivity characteristics.

Practically all roentgen therapists now recognize, in the treatment of malignant disease, that it is advisable to give an erythema dose of rays into the tumor area or as nearly as circumstances will permit, in a short time (a few days) and to repeat this dose after an interval of time. This interval, after which we may safely repeat an erythema dose, will vary with the character of radiation used. We know from clinical experience, that it is from two to three weeks for unfiltered rays with a mean wave length of about 0.35A; for medium hard rays of approximately 0.23 Å (9 in. parallel spark gap, 127 kv., and 6 mm. Al filter) is from four to six weeks, and with a wave length of 0.165 Å (200 kv. and 0.5 mm. Cu + 1 mm. Al filter) is from eight to twelve weeks.

We know that cumulative effects occur even from small unmeasured repeated doses, and that late degenerative effects may occur from excessive radiation no matter at what interval it is repeated. We also know from clinical and experimental work that malignant cells become desensitized after a time to the effects of radiation and that, therefore, the total radiation should be applied, in as short a period as is consistent with the health of the general organism.

A number of investigators, especially Mohr,[28] Hertwig,[29] Holthusen,[30] Regaud,[31] Markowits,[32] and others have shown that cells are most sensitive to radiation during the process of division.

Regaud and his followers, as a result of the study of the karyokinetic index, and with the object of influencing all of the malignant cells during the process of division, use either continuous radiation from radium or discontinuous roentgen radiation over a period of days or weeks. As a result of animal experiments, Regaud,[31] Nather and Schinz,[33] and Alberti and Politzer,[34] by following the above plan of exposure have obtained an increased

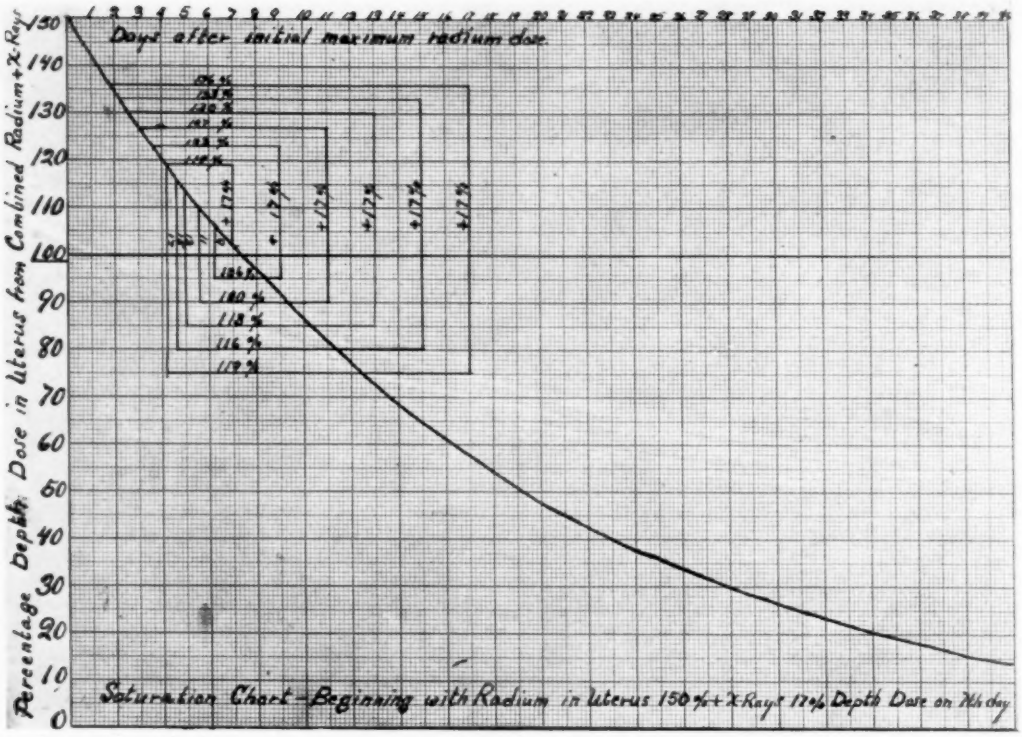
Days after initial maximum radium dose.
Percentage Depth Dose in Uterus from Combined Radium + X-Rays
Saturation Chart - Beginning with Radium in Uterus 150% + X-Rays 17% Depth Dose on 7th day

FIG. 5. Prepared on the basis of a primary application of radium corresponding to 150 per cent in the uterine canal; on the seventh day there will be approximately 100 per cent left in the uterine area. If then 17 per cent depth dose is added on alternate days, by the seventeenth day this uterine area will be returned to approximately 136 per cent, and the remainder of the pelvic area will be kept at approximately 100 per cent. These six doses can be given through three different areas with approximately 50 per cent surface application at each treatment. This seems to work satisfactorily. All treatment must, however, be controlled by clinical judgment.

biological effect. Alberti and Politzer found, after a single exposure of the cornea of salamanders, a cycle of cell reaction. Immediately after exposure there was noted a "primary effect," indicated by pseudomitosis, then followed a period of about three days when mitosis was again noted, called "secondary effect." They found that by dividing their doses into two parts, so that the second dose was given at the height of a "secondary effect" the biological result was increased two and a half times.

As a result of this brief review of our present practical knowledge of the biological effects, it seems to me clear that it is our duty in the treatment of deep-seated malignant disease to administer to the tumor area the largest dose (an erythema dose, "saturation") that is practical within a short time and without damage to surrounding essential normal tissue or organs. This dose, when divided, should be given on successive days, so as to avoid the development of a decreased sensitivity of the malignant cells. We should then continue this saturation over a period long enough to destroy all carcinoma cells during their process of division, and yet not long enough to obtain a cumulative or destructive effect upon normal tissues, nor a late degenerative effect. We, therefore, approximate "saturation" as quickly as possible, and continue it during a period of ten to fourteen days.

Figure 3 shows a chart to be used with medium hard rays, with which we have found clinically that a full dose could be repeated in from four to six weeks, and Figure 4 shows a similar chart based upon a repetition of a full dose at the end of two to three months, using a more penetrating ray. The curve is based upon the fact that the effect of irradiation wears off most rapidly at the beginning.

THE SATURATION METHOD AS APPLIED TO RADIUM

The saturation method of multiple dose radiation therapy can be applied to the use of radium insofar as the *toleration dose* ("saturation") is known, providing that the interval of time is also known after which such a dose can be repeated. This will vary with the various qualities of beta and gamma rays. So far as our present knowledge goes, these factors must be determined by clinical experience. Figure 5 will serve to illustrate the method by which the radiation from radium and roentgen rays may be combined in the treatment of carcinoma of the uterus. This is only an example. Further experience may show that this period of application should be either lengthened or shortened and the condition of the patient may require smaller, or more oft repeated doses.

ADVANTAGES OF THE SATURATION METHOD

1. By delivering the maximum radiation in the shortest practical period of time, one obtains all the advantages of the single massive dose in its destructive effect upon the malignant cells.

2. By continuing this maximum effect for ten to fourteen days thereafter, one may expect to irradiate all cancer cells during the process of division.

3. By somewhat dividing the dose, one avoids the profound radiation effect upon the general organism.

4. In our experience the saturation method has given better clinical results than has been obtained by any other means. This statement is based upon a radiotherapeutic experience of over twenty-five years.

DISADVANTAGES OF THE SATURATION METHOD

1. Much more time is consumed in the repeated arrangement of the patient for multiple exposure and thereby the total expense of treatment is increased.

2. Great caution is necessary to avoid overdosage from cumulative effects.

3. There is more opportunity for the patient to interrupt the treatment before all diseased cells have been destroyed.

4. It is difficult at present to determine how long this saturation effect must be maintained in the individual case. Sometimes it seems advisable to add more treatment after two months if any evidence of disease remains, but such addition involves risk of secondary degeneration

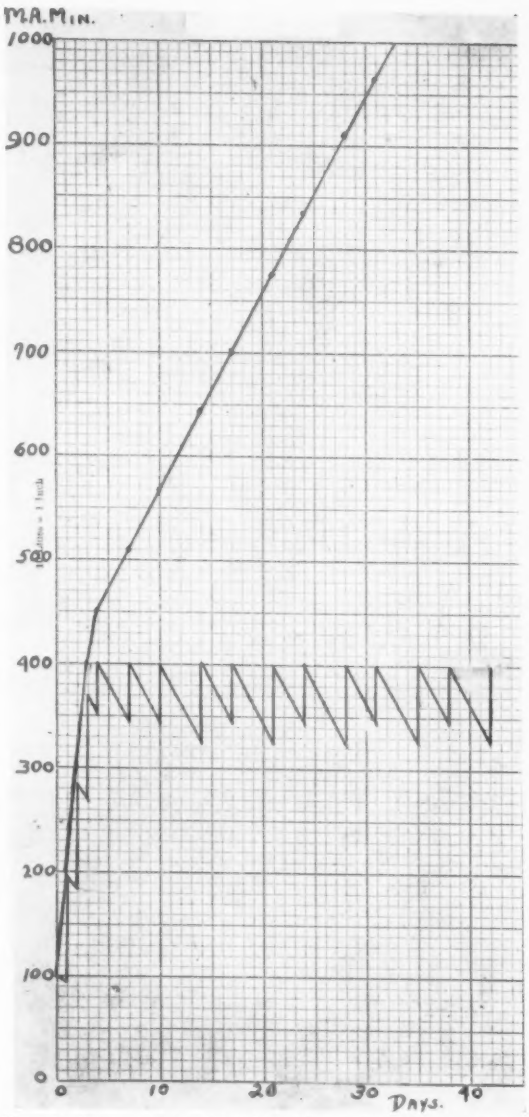

FIG. 6. Prepared by Dr. Weatherwax as a method of recording the saturation values. The vertical lines represent days; the horizontal lines represent milli-ampere-minutes. His estimate is that 400 ma-min. represents the average erythema dose, with 200 kv., 0.5 mm. Cu plus 1 mm. Al at 50 cm. distance. In this chart, the erythema dose value in the tumor area is reached in four days. The oblique line extending upward indicates the total value of accumulated dosage in the tumor area which in this chart is represented as two and a half erythema doses within a period of thirty-three days.

and the cumulative or total value must be kept constantly in mind in relation to the amount of tissue irradiated and the condition of the circulation within that tissue.

Since presenting my first paper in London two years ago, and, in fact, during the past three years we have used the saturation method in practically all of our work in my private institute and in the three hospitals with which I am connected. All of my associates are convinced of the superiority over all other methods. My other colleagues in the other hospitals of Philadelphia are also favorably impressed.

We are preparing some statistics bearing upon the subject which we hope to present at a later date.

REFERENCES

1. KINGERY, L. B. Saturation in roentgen therapy: Its estimation and maintenance. A preliminary report. *Arch. Dermat. & Syphilol.*, 1920, i, 423–433.
2. HAZEN, H. H., and WHITMORE, E. R. The end results in roentgen-ray treatment of cutaneous cancer. AM. J. ROENTGENOL. & RAD. THERAPY, 1925, xiii, 144–156.
3. MACKEE, G. M. X-Ray and Radium in the Treatment of Diseases of the Skin. Lea & Febiger, Philadelphia, 1921.
3½. PFAHLER, G. E. Saturation method in roentgen-therapy, as applied to deep-seated malignant disease. *Brit. J. Radiol.*, 1926, xxxi, 45–58.
4. HOLFELDER, H. Die geeignete, zeitliche Verteilung der Röntgendosis "Das Problem" in der Strahlentherapie. *Arch. f. klin. Chir.*, 1925, cxxxiv, 647–662.
5. FRIEDRICH, W., and GLASSER, O. Untersuchungen und Betrachtungen über das Problem der Dosimetrie. *Strahlentherapie*, 1922, xiv, 362–388.
6. DUANE, WILLIAM. Measurement of roentgen radiation by means of an ionization chamber and galvanometer. *Proc. Am. Roentgen Ray Soc.*, 1914; Roentgen rays of short wave lengths and their measurement. AM. J. ROENTGENOL., 1922, ix, 167–171.
7. JÜNGLING, O. Untersuchungen zur chirurgischen Röntgentiefentherapie. *Strahlentherapie*, 1920, x, 501–584.
8. DESSAUER, F., and VIERHELLER, F. Die Tiefenwirkung der Röntgenstrahlen. *Strahlentherapie*, 1921, xii, 655–690.
9. VOLTZ. Dosierungstabelle für die Röntgentiefentherapie. Lehmanns Verlag, München, 1920.
10. SEITZ and WINTZ. Unsere Methode der Röntgentiefentherapie. Sonderband der Strahlentherapie, Urban and Schwarzenberg, 1920.
11. GLOCKER, R., ROTHACKER, O., and SCHÖNLEBER, W. Neue Methoden zur Messung der Tiefendosis im Wasserphantom. *Strahlentherapie*, 1922–23, xiv, 389–422.
12. HOLFELDER, HANS, BORNHAUSER, O., and YALOUSSIS, E. Über die Intensitätsverteilung der Röntgenstrahlen in der Körpertiefe. I. Welchen Einfluss übt der Fokusoberflächenabstand und die Grösse, Form und Lage der Blende auf die Intensitätsverteilung im Wasserphantom aus? *Strahlentherapie*, 1924, xvi, 412–446.
13. FRICKE, HUGO, and GLASSER, OTTO. Studies on the physical foundations of roentgen-ray therapy. AM. J. ROENTGENOL. & RAD. THERAPY, 1924, xi, 435–442.
14. GAYLORD, H. R., and STENSTROEM, K. W. Comparative measurements between radium and x-rays concerning energy absorbed at depth. AM. J. ROENTGENOL. & RAD. THERAPY, 1923, x, 56–62.
15. COLIEZ, ROBERT. Les bases physiques de l'irradiation du cancer du col uterine par la curiethérapie et radiothérapie combinées. *J. de radiol. et d'électrol.*, 1923, vii, 201.
16. HOLFELDER, H. Das Problem der räumlich homogenen Dosierung in der chirurgischen Röntgentiefentherapie und seine Lösung durch den Felderwähler. *München. med. Wchnschr.*, 1920, lxvii, 926–928.
17. HOLFELDER, H. Irrtümer und Gefahren der Röntgentherapie und deren Verhütung. Röntgendiagnostik und Strahlentherapie. Heft iv, George Thieme, Leipzig, 1924.
18. HOLZKNECHT, G. Röntgentherapie, Revision und neuere Entwicklung. Urban und Schwarzenberg, 1924.
19. CASPARI, W. Tumor und Immunität. *Strahlentherapie*, 1923, xv, 831–842. Betrachtungen über das Krebsproblem, besonders von Standpunkte der Immunität. *Ztschr. f. Krebsforsch.*, 1922–23, xix, 74–100.
20. MURPHY, J. B., and his coworkers at the Rockefeller Institute. Twelve articles in the *Journal of Experimental Medicine*, 1915–1923.
21. WOOD, F. C., and PRIME, F. The lethal dose of roentgen rays for cancer cells. *J. Am. M. Ass.*, 1920, lxxiv, 308.
22. KEYSSER. Neue Wege zur biologischen Dosierung der Röntgenund Radiumstrahlen in der Geschwulstbehandlung auf Grund neuer Feststellungen über die Strahlenwirkung auf Impftumoren. *München. med. Wschnschr.*, 1921, lxviii, 4–8. Die praktische Durchführung meines Vorschlages der biologischen Dosimetrie in der Strahlenbehandlung der bösartigen Geschwülste unter Berücksichtigung der mittelbaren Strahlenwirkung. *München. med. Wchnschr.*, 1921, lxviii, 543–544.
23. KOK, F., and VORLAENDER, K. Biologische Versuche über die Wirkung der Bestrahlung auf das Karzinom. I and II. *Strahlentherapie*, 1922–23, xiv, 497–515; 1923, xv, 561–604.
24. RUSS, S. Effects of x-rays of different wave-lengths upon some animal tissues; proof of differential action. *Lancet*, 1923, ii, 637–640. Experimental studies upon the lethal doses of x-rays and radium for human, and other tumors. *Brit. J. Radiol.*, 1924, xxix, 275–292.
25. JÜNGLING, O. Röntgenbehandlung chirurgischer Krankheiten zugleich Einführung in die physikalischen und biologischen Grundlagen der Röntgentherapie. S. Hirzel, Leipzig, 1924.
26. SEITZ, L., and WINTZ, H. Grundsätze der Röntgenbestrahlung des Gebärmutterkrebses und des Karzinoms im Allgemeinen. Die Karzinomdosis. *München. med. Wchnschr.*, 1918, lxv, 89–92.
27. FRIEDRICH, W., and KRÖNIG, B. Die Strahlenbehandlung des Brustkrebses in einer einmaligen

Sitzung. Festlegung der Karzinomdosis. *München. med. Wchnschr.*, 1916, lxiii, 1445–1447.
28. Mohr, O. L. Mikroskopische Untersuchungen zu Experimenten über den Einfluss der Radiumstrahlen und der Kältewirkung auf die Chromatinreifung und das Geterochromosom bei Decticus verruccivorus. (♂). *Arch. f. mikroskop. Anat.*, 1918–19, xcii, 300–368.
29. Hertwig, G. Das Radiumexperiment in der Biologie. *Strahlentherapie*, 1920, xi, 821–850.
30. Holthusen, H. Über die biologische Wirksamkeit von Röntgenstrahlen verschiedener Wellenlänge. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1919–21, xxvii, 213–244.
31. Regaud, C. Le période de latence dans les effets biologiques des rayons x et γ. Son explication histophysiologique. *Bull. de l'Acad. de méd.*, 1923, xc, 375–379. Regaud, C., and Lacassagne, A. A propos des modification determinées par les rayons x dans l'ovaire de la lapine. *Compt. rend. Soc. de biol.*, 1922, lxxxvii, 938–940. Regaud, C. Some biological aspects of the radiation therapy of cancer. Am. J. Roentgenol. & Rad. Therapy, 1924, xii, 97–101.
32. Markovits, E. Ueber die Einwirkung des Mesothoriums auf Einzellige. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1921, xxviii, 22–26.
33. Nather, K., and Schinz, H. R. Tierexperimentelle Röntgenstudien zum Krebsproblem. 1. Gibt es eine Reizdosis bei malignen Tumoren? *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1923, xxxvi, 620–660.
34. Alberti, W., and Politzer, G. Experimentalbiologische Vostudien zur Krebstherapie. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1924, xxxii, 56–64.

THE MEASUREMENT OF EFFECTIVE WAVE LENGTHS

BY WILLIAM DUANE, PH.D., J. C. HUDSON, A.M., AND HELEN N. STERLING, A.B.

BOSTON, MASSACHUSETTS

A PAPER published recently in the American Journal of Roentgenology[1] described the measurement of the effective intensity of roentgen rays for therapeutic purposes. In the present paper, we describe the measurement of the effective *wave length* of such radiation.

The effective wave length, λ_e, may be defined, in general, to be the wave length of monochromatic radiation that would produce the same effect (readings of the instruments employed, etc.) that the actual radiation produces. In the employment of roentgen rays in the treatment of disease, the absorption of the radiation is of prime importance. For this reason it is advisable to determine the effective wave length of the radiation in an absorption measurement and we have adopted for this purpose a measurement of the percentage of radiation that passes through a sheet of some material such as copper or aluminum. This measurement of the amount of radiation that passes through furnishes an estimate of the penetration of the radiation. The effective wave length of a given beam of roentgen rays depends upon the particular measurements that one is making. In the case of the radiation passing through the sheet of copper, or aluminum, the effective wave length is the wave length of the monochromatic beam of rays for which the reading of the measuring instrument would be reduced in the same ratio as for the actual beam, when the sheet of absorbing material is placed in the path of the rays.

The fractions of monochromatic roentgen rays of different wave lengths that pass through sheets of copper or aluminum are quite accurately known from the experiments of Richtmyer, Allen and others. A recently published book on *x*-rays by A. H. Compton contains, on page 184, a very convenient summary of these absorption researches. The fraction of radiation passing through a sheet of matter of thickness d is given by the equation

$$\frac{I}{I_0} = e^{-\frac{\mu}{\rho}(\rho d)}$$

in which ρ is the density of the material and μ the coefficient of absorption. The values of $\frac{\mu}{\rho}$ are given in the tables contained in the above references and ρd is the weight of the sheet of matter per square centimeter. The curves in Figure 1 have been drawn from these data. One pair of curves, A, lying close together is for aluminum and the other pair, B, for copper. Two curves are drawn together

for the following reason. Sheets of copper and of aluminum supposedly of the same thickness are not always exactly so. It is much easier to determine accurately the average weight of a thin plate per square centimeter, by dividing its total weight by its area, than it is to measure its average thickness. The copper curve marked 0.215 grams per square centimeter is for a sheet of copper purchased from one of the commercial companies and having a thickness of very nearly 0.25 mm. The curve 0.230 grams per square centimeter is for a sheet of copper slightly thicker than 0.25 mm. If the sheet of copper actually employed in any particular case has approximately either of these weights per square centimeter, it is not difficult to draw the curve that should be used for it, either by interpolating from the curves of the figure or by re-calculating from the data mentioned above. The upper of the two aluminum curves, A, 0.526 gram per square centimeter, is for sheets of aluminum totalling about 2 mm. in thickness. The lower of the two is for a thickness of aluminum slightly greater than 2 mm.

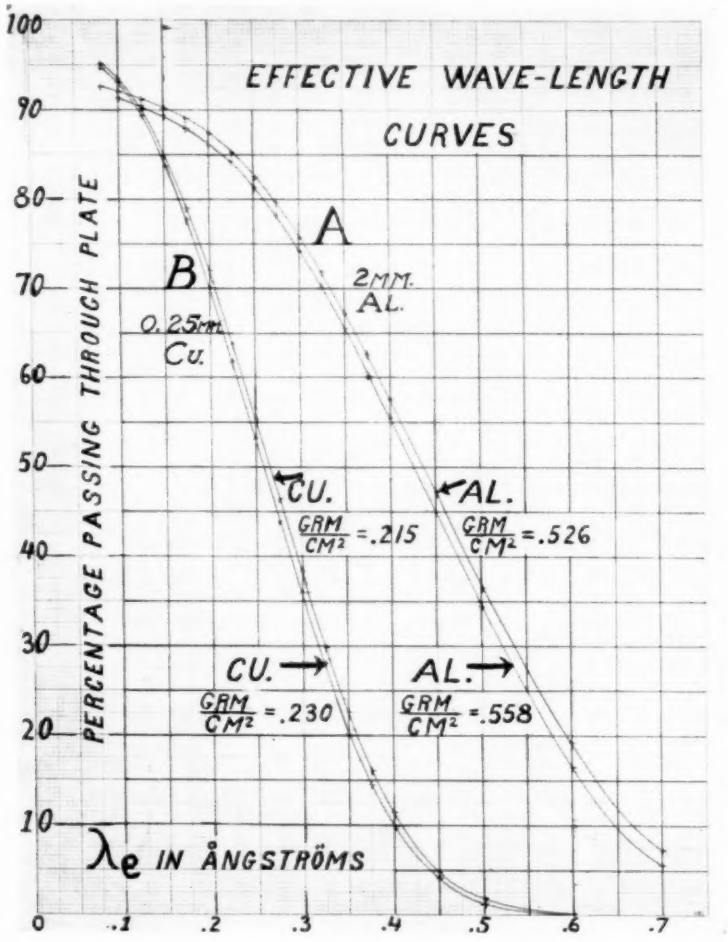

FIG. 1.

In choosing the proper material to use for determining effective wave lengths several points should be taken into consideration. Firstly, as explained in a previous paper,[3] sheets of chemical elements of medium and high atomic weights should not be employed because the absorption of roentgen rays used for therapeutic purposes varies in a peculiar and erratic manner on account of the characteristic

changes in absorption that occur at what are called critical absorption wave lengths. The critical absorption wave lengths of copper and aluminum are much longer than those of ordinary therapeutic roentgen radiation, and, in the region of such radiation, they show none of these erratic variations of absorption. Secondly, chemical elements of very low atomic weight should not be employed, for the absorption of such material does not change very much with the wave length in the region of short rays usually employed in deep roentgen therapy. The curves for aluminum in the figure show this; for a change of wave length from 0.2 to 0.1 increases the amount penetrating the aluminum sheet by only 4 or 5 per cent. Aluminum, therefore, has too low an atomic weight to be used properly in the measurement of the quality of short wave length radiation. Of those chemical elements which may be used efficiently for measurement of the effective wave length, copper appears to be the most suitable. If the thickness of the copper plate is about 0.25 mm. the percentages passing through it range from 22, or so, for a wave length of 0.35 to about 90 for a wave length of 0.12, and this is the range of wave lengths usually employed in therapy, except for very superficial treatments. In the case of such superficial treatments, where wave lengths ranging from 0.35 to 0.7 are employed, 2 mm. of aluminum may be used efficiently.

The effective wave lengths contained in Table 1 have been selected from measurements made from time to time in our laboratory. They illustrate the effective wave lengths that may be expected under

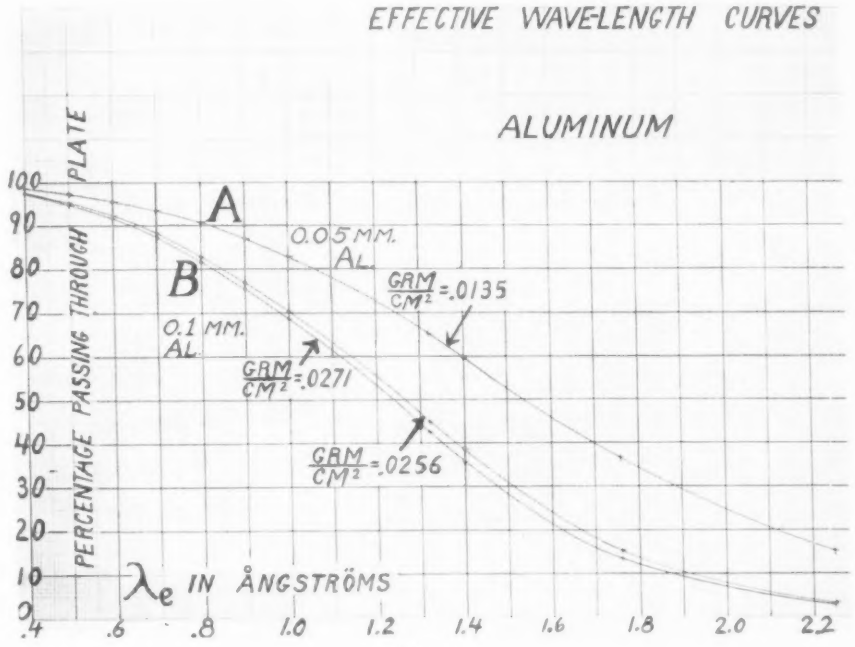

FIG. 2.

TABLE 1

Voltage	Gm. of cm.² filter	λ_e Cu	λ_e Al
97,600	0.214 Al	0.358	0.433
97,600	0.529 Al	0.325	0.385
98,600	0.843 Al	0.305	0.353
98,100	1.057 Al	0.293	0.337
96,200	1.327 Al	0.285	0.323
98,600	0.1004 Cu	0.251	0.293
97,050	0.392 Cu	0.225	0.248
80,400	0.214 Al	0.377	0.468
79,550	0.529 Al	0.347	0.407
78,000	0.843 Al	0.330	0.378
79,550	1.057 Al	0.317	0.358
79,550	1.327 Al	0.306	0.342
79,550	0.1004 Cu	0.282	0.322
160,000	0.1004 Cu	0.227	.....
160,000	0.392 Cu	0.208	.....
160,000	0.462 Cu	0.205	.....
200,000	0.462 Cu	0.177	.....
200,000	0.859 Cu	0.155	.....
220,000	0.462 Cu	0.171	.....
220,000	0.859 Cu	0.144	.....

various conditions. λ_1 in column three represents the effective wave lengths as measured by a copper sheet about 0.25 mm. thick ($\rho d = 0.215$); λ_2 in column four is measured by means of an aluminum sheet about 2 mm. thick ($\rho d = 0.538$).

Glasser and Portmann[2] have emphasized the importance of measuring the intensity and quality of roentgen radiation used in extremely low voltage treatments. In the neighborhood of 5 to 15 kv., both the intensity and the quality of the radiation vary greatly with slight changes in the thickness of the window of the roentgen-ray tube. To enable one to estimate the effective wave length of such radiation the curves in Figure 2 have been drawn. Aluminum may be used as the absorbing material in this case. The curve, B, marked 0.0271 grams per square centimeter is for a sheet of aluminum about 0.1 mm. thick; that marked 0.0256 is for a sheet slightly thinner than 0.1 mm. and curve, A, is for a sheet about one half as thick as the others.

The paper referred to above[1] contains, among other things, an account of some experiments to determine how far apart the parallel plates of our standard ionization chamber should be in order to correctly measure roentgen rays. We have repeated these experiments with the tube running at 200,000 volts (constant, non-fluctuating voltage) and furnishing radiation with an effective wave length of 0.16 A. To measure correctly such a beam the plates should be about 8 or 9 cm. apart.

Many of those who employ constant voltage machines for generating roentgen radiation have had considerable difficulty in obtaining good roentgen-ray tubes that would stand up under high voltage conditions. We have adopted the following scheme for protecting the tubes when running at such voltages. We place in series with the roentgen-ray tube resistance coils totalling several hundred thousand ohms. The best procedure seems to be to place between the generator plant and the roentgen tube coils totalling something like 200,000 ohms, and a second set of coils of about the same resistance between the negative terminal of the generating plant and the battery or transformer that supplies the heating current for the Coolidge cathode. Although such resistances may use up a few thousand volts, they have proved of immense value in protecting tubes against sudden, heavy discharges. By using these resistances it is possible to increase very considerably the voltage that a given tube will stand. For example, one quite gassy tube, which would not run above 110,000 volts without the resistances, ran quite well at 170,000 volts when the resistances were put in. With the resistance in place, we frequently run ordinary commercial tubes at 220,000 volts (constant non-fluctuating voltage) without their showing signs of distress. How much above 220,000 we can raise the voltage we do not know, as we have not cared to risk injuring the generating plant in its present state.

The effective wave length of a given beam of roentgen radiation depends to some extent upon the particular thing that is being measured. For instance, if we measure the effective wave length by means of 0.25 mm. copper, we get a slightly larger value than we do if we measure the effective wave length by means of 1 mm. copper. This obviously must be so, for the radiation passing through the millimeter of copper is filtered more than that which passes through 0.25 mm. copper. On the average, therefore, the radiation measured with the millimeter of copper will have a somewhat shorter wave length than that measured by 0.25 mm. copper. This, indeed, is the principle of filtration; for we use filters in order to shorten up the effective wave length.

The effective wave length of a beam depends obviously on the voltage applied to the tube, the filtration, the type of machine used, etc., etc. Beams of the same effective wave length can be produced in a variety of different ways, at different voltages and filtrations and with different machines, etc.

The effective wave length in a given case can be determined by a *single* measurement in addition to that of the intensity of the beam. It probably gives us more information about the quality of the radiation than can be obtained in any other way by such a single measurement. The deter-

mination of the half-value layer requires many more than a single measurement.

Obviously, if a complete absorption curve is obtained from a lot of measurements, a more detailed knowledge of the quality of the radiation can be acquired. Further, spectrum analysis, as illustrated in a previous paper,[3] gives a still better idea of quality.

A mathematical expression for the effective wave length, λ_e, has been given[4]. If $f(\lambda)$ is the coefficient of absorption of the material for the wave length, λ, and, if $I(\lambda)$ is the intensity of the radiation at the wave length, λ, then the effective wave length is given by the mathematical equation

$$e^{-f(\lambda_e)d}\int_0^\infty I(\lambda)d\lambda = \int_0^\infty I(\lambda)e^{-f(\lambda)d}d\lambda$$

Those who have not been in the habit of using mathematical symbols may regard the above equation simply as a kind of shorthand method of expressing a number of things quantitatively.

REFERENCES

1. Duane, William, and Lorenz, Egon. The standard ionization chamber for roentgen-ray dosage measurements. Am. J. Roentgenol. & Rad. Therapy, May, 1928, xix, 461–469.
2. Glasser, Otto, and Portmann, U. V. The physical and clinical foundations of oversoft roentgen-ray (grenz-ray) therapy. Am. J. Roentgenol. & Rad. Therapy, May, 1928, xix, 442–452.
3. Duane, William. The scientific basis of short wave-length therapy. Am. J. Roentgenol., 1922, ix, 781–791.
4. Duane, William. *Proc. Nat'l Acad.*, 1927, xiii, 668.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: ARTHUR C. CHRISTIE, M.D.

Associate Editor: LAWRENCE REYNOLDS, M.D.

Editorial Board: JAMES T. CASE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

Advisory Board for Pathology: JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

Foreign Collaborators: A. BÉCLÈRE, M.D., PARIS. GÖSTA FORSSELL, M.D., STOCKHOLM. G. F. HAENISCH, M.D., HAMBURG. ROBERT KNOX, M.D., LONDON. R. LEDOUX-LEBARD, M.D., PARIS.

Publishers. PAUL B. HOEBER, INC., NEW YORK

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 1909 Massachusetts Ave., N. W., Washington, D.C. Office of publication, 76 Fifth Avenue, New York.

Information of interest to all readers will be found on page ii.

Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President: A. HOWARD PIRIE, Montreal, Canada; *President-Elect:* E. H. SKINNER, Kansas City, Mo.; *1st Vice-President:* R. D. LEONARD, Boston, Mass.; *2d Vice-President:* LAWRENCE REYNOLDS, Detroit, Mich.; *Secretary:* JOHN T. MURPHY, 421 Michigan Ave., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, Toledo, Ohio.

Executive Council: WILLIAM DOUGHTY, Chairman, 628 Elm St., Cincinnati, Ohio, G. W. GRIER, Pittsburgh, Pa., W. F. MANGES, Philadelphia, Pa., A. H. PIRIE, Montreal, Canada, E. H. SKINNER, Kansas City, Mo., A. C. CHRISTIE, Washington, D. C., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

Committee on Laws and Public Policy: B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

Safety Committee: P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

Committee on Scientific Exhibit: LAWRENCE REYNOLDS, Chairman, 10 Peterboro St., Detroit, Mich., IRA H. LOCKWOOD, Kansas City, Mo., LEWIS G. ALLEN, Kansas City, Mo.

Publication Committee: WILLIAM A. EVANS, Chairman, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., W. F. MANGES, Philadelphia, Pa.

Member, National Research Council: GEORGE W. HOLMES, Boston, Mass.

Editor: A. C. CHRISTIE, 1909 Massachusetts Ave. N. W., Washington, D. C.; *Associate Editor,* Lawrence Reynolds, Detroit, Mich.

Editorial Board: JAMES T. CASE, H. K. PANCOAST, WM. DUANE.

Advisory Board for Patbology: JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

Publishers: PAUL B. HOEBER, INC., 76 Fifth Avenue, New York City.

Twenty-ninth Annual Meeting: Hotel President, Kansas City, Mo., Sept. 25–28, 1928.

THE AMERICAN RADIUM SOCIETY

President: EDWIN C. ERNST, Beaumont Medical Building, St. Louis, Mo.; *President-Elect:* H. H. BOWING, Rochester, Minn.; *First Vice-President:* WILLIAM P. HEALY, New York City; *Second Vice-President:* WILLIAM E. COSTOLOW, Los Angeles, Calif.; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Pittsburgh, Pa.

Executive Committee: DOUGLAS QUICK, Chairman, New York City; ALBERT SOILAND, Los Angeles, Calif.; CURTIS F. BURNAM, Baltimore, Md.

Program Committee: H. H. BOWING, Chairman, Rochester, Minn.

Publication Committee: HENRY K. PANCOAST, Chairman, Philadelphia, Pa.; JAMES T. CASE, Battle Creek, Mich.; R. E. LOUCKS, Detroit, Mich.

Standardization Committee: G. FAILLA, Chairman, New York City; HENRY J. ULLMANN, Santa Barbara, Calif.; ROBERT B. GREENOUGH, Boston, Mass.

Fourteenth Annual Meeting: Portland, Oregon, July 8–9, 1929.

Committee on Arrangements: To be announced.

EDITORIALS

ADDRESS OF THE PRESIDENT OF THE AMERICAN RADIUM SOCIETY*

BY CURTIS F. BURNAM, M.D.

BALTIMORE, MD.

OUR Society holds a unique place in the medical radium field; it is the one organization solely devoted to this general problem, and it numbers among its members many of the best scientific and clinical radium workers. While this position is a matter of congratulation and of great pleasure, it also entails very serious obligations. It is our duty to see that progress continues, that old methods be constantly refined, that new technics be developed, that an increasing number of capable medical workers be brought into our field and make it their own, that hospitals be encouraged to develop and equip radium departments, that the firmly established results be brought to the knowledge of both the professional and lay publics, that harmful superstitions and beliefs as to the injuries and dangers be removed from all but the most bigoted minds, that wherever possible the newer discoveries in physics, chemistry, biology and medicine, be taken up and made to show the path next to be taken by the radium explorer.

Although radium has been used in medicine for more than a quarter of a century, and our own Society is celebrating its thirteenth anniversary, we are still in the pioneer stage. It seems to me that the remarkable accomplishments already attained are but a forecast of what the future may develop. Like the first hardy settlers in a new land we have found many unexpected riches, but have not systematically worked the soil nor built up efficient methods. This rests with those who are going to carry on the work, and surely their returns will be much more abundant, although it is doubtful whether there will be the same acute joy in the pursuance of this end, for it means more thought, more concentration, and more specialization.

When it is remembered that the dermatologist, the gynecologist, the urologist, the ophthalmologist, the nose and throat specialist, the orthopedist, the general medical man, and the surgeon are all in frequent need of radium therapy, in order to do good work, it would seem an inevitable corollary that every hospital should be equipped with the radium, appliances for using it, and especially with well-trained radium specialists to administer or consult in the administration to patients. The position should be as important as that of the pathologist or the surgeon of the hospital. If some such development in our hospital plans takes place there will be a call for many workers, and thousands of patients who are not treated at all, or inefficiently treated, will be well taken care of. We should take into this Society and put on its programs as rapidly as possible, all the men and women who are actually doing good work in our field.

All of us will agree that ideal or perfect dosage will never be attained in practice, but that the nearer it is approximated the better the results as measured in cures will be. It does not fall within my scope to discuss the existing methods of physical measurement and their application in human radiation. Decidedly greater progress has been made with roentgen-rays than with radium. The accurate determination of the extent of regions to be irradiated and of their depths from the surface, is difficult and for the different regions of the body it would be of great advantage if systematic and comprehensive studies were

* Presented before the Thirteenth Annual Meeting of the AMERICAN RADIUM SOCIETY, Minneapolis, Minn., June 11, 1928.

made and methods developed to reduce this problem to a simple and accurate scheme.

Many of the fundamental biological ground-stones to the best method of irradiation are as yet not clearly defined. Are the long weak exposures such as are practiced in France of advantage or disadvantage? Personally, I am unable to definitely answer this question, and I am sure that there would be no consensus of opinion. Is there a difference in the biological effect of wave lengths, independent of the quantity absorbed and dependent on the length of the wave? While considerable experimental evidence is against this variation there is much clinical evidence in favor of it. Real progress as to radiosensitivity has been made in connection with the grading of tumors as to malignancy, and is becoming a guide in both prognosis and treatment. However, radiosensitivity is but imperfectly understood, and tumors of exactly the same histological appearance require very different dosages to produce similar effects. Is this due to a difference in the resistance of the host? It would seem so. There is at present no method of determining what this resistance may be. How shall we go about developing methods that will help us to answer this question? Wherever we cast our eyes we are met by problems of a fundamental nature. Had we accurate information it would render the problems of practical treatment infinitely simpler.

In practice as well as in scientific investigation, association with experts in other fields is indispensable, team-work often leads to results otherwise unobtainable. Let us interest and help in practice other medical men. The gynecologist should judge the field and the results in gynecology; the nose and throat specialist the effects in treating and selecting cases in that specialty; show the surgeon that radiation in addition to operation cures more breast cancers than operation alone, and he will work with us.

The work actually accomplished by radium should be made known to both the profession and to the public. It is most important to make no claims which cannot be fully proven. This only carries us along side-tracks and leads into blind alleys and delays real progress. My impression is that in making reports we should once more revert strongly to the technical side of the case, explain in detail the problem and the method by which it is met. While not at all disparaging the reporting of results, these should be given less prominence and more to the way they have been secured. If this method is followed results will go along *pari passu*.

For the most part if not completely, injuries of a serious nature from radium should not and do not occur if it is used in a way that we can all know about at the present moment. Several years ago a brilliant surgeon was our guest and showed us some remarkable plastic results obtained after severe injuries; he said in substance, that with surgery developed as it was, radium could be used vigorously and even if injuries occurred they were not irreparable. He showed some frightful mutilations in birthmarks. There should not be any injury in treating angiomata. Such injuries are due to the man behind the radium and not to it. This holds for many other conditions. Radiation in the treatment of uterine fibroids and bleeding cases, has proven an extremely safe and efficient agent. There is nevertheless, both in the professional and public mind unjustifiable prejudices against it. It is said that the artificial menopause produces high blood pressure, rheumatism, mental and nervous disturbances, loss of sex and many other undesirable conditions. All of these statements are untrue; none of these conditions follow the treatment, and a long series of personal observations has convinced me that the nervous and psychical states are better after than before the production of the artificial menopause. It is true that if psychoneurotic patients are constantly suggested to that almost any symptom may develop. These facts should be plainly and definitely understood, both by the radiologist, the consulting physician and the patient. We are all familiar with the sclerosing effects of intense radiation as in a cervix cancer, or in any part of the body where radium is buried, and that operation is rendered more difficult. This has been applied to all kinds of radiation.

First class surgeons and men of the highest honesty will state at operation that the removal of a thyroid, or of a fibroid tumor, is greatly complicated by the adhesions following irradiation which is always external, and which may have been of a character insufficient to cause a skin depilation. It should be our business to teach them the difference in effects from different kinds of radiation. The wide publicity given in the daily press to the poisoning of girls working in a luminous watch dial factory, has been very trying to nervous patients. While quite unable to tell whether these illnesses and deaths were due to radium, it is evident that the eating of radium is quite a different thing from its use in medicine, and yet, this is never made clear to the readers, and people are terrified. The idea of some very good medical men that aplastic anemias are likely to follow radium exposures, belongs in a similar class to what might justifiably be dubbed superstitions. I remember a case of a woman with a very bad heart and an intractable menorrhagia in whom operation seemed very hazardous, but the medical man in charge said that aplastic anemia was so likely that it counterbalanced the dangers of anesthesia, thrombosis, etc., associated with operation. As a matter of fact, I have never seen, nor do I believe that an intrauterine dose of radium sufficient to produce amenorrhea, would ever produce aplastic anemia, or perhaps any anemia. Without multiplying examples further, it would seem that the time is at hand for us who know the facts, to make known, not only our successes and the methods of obtaining them, but also to thoroughly remove these misconceptions which do incalculable harm to patients, and impede real progress in developing proper treatment.

In conclusion, I propose that at this meeting we appoint a committee whose aim will be to set down briefly a list of the conditions in which radium is preferable to all other methods of treatment. A second list in which it is a valuable aid to other methods; thirdly, a list in which it is in a small percentage of cases of value, and fourthly a list in which it has proven of no apparent value. That the harmful effects of over-dosage be clearly stated, and likewise the absence of such effects under normal treatment. That a clear listing of the fundamental physical biological and clinical facts, which are not known, but which would clarify our conceptions, and simplify the principles of treatment be made, and that work be encouraged along these lines. Should such a committee be appointed they should end by presenting their conclusions to every member of this Society for criticism, amplification, or whatever else seems best to the individual, and when finally the work is finished, that it be published in the official journal of the Society.

THE FIRST DECADE OF AMERICAN ROENTGENOLOGY*

BY P. M. HICKEY, M.D.

ANN ARBOR, MICHIGAN

In considering the development of roentgenology during the first decade, we must not omit the work of Dr. Percy Brown. Along with his medical studies he became very much interested in photography, especially the so-called Impressionistic School. And so when he noticed the work of some of his confreres in the new art of roentgenology, he became convinced that attention to the development of the photographic side would be an interesting problem. His first work was done in the X-ray Department of the Boston Children's Hospital, and though he had prepared himself especially in orthopedic surgery, he drifted away from that branch and ultimately declared himself publicly for the vocation, new x-ray photography, much against the advice of his many friends.

Dr. Brown's mastery of the English language and his forceful though at times quaint diction have always made his contributions most interesting. Like Caldwell, he maintained a workshop in which he delighted to fashion with his own hands many of the devices which he found of value in producing technical work of the highest excellence. However, the clinical deductions which he drew from his most

* Continued from the August issue of the Journal.

excellent plates were held in high esteem by his professional brethren. From the start, Dr. Brown took a keen interest in the teaching of roentgenology, and the hope which he had in his early career, namely, that the Harvard Medical School would ultimately establish a department of roentgenology has been fulfilled. It is a matter of comment that some of the prominent medical schools have been so dilatory in realizing the necessity of according to roentgenology the dignity of a separate department.

With the announcement of Roentgen's discovery, the ophthalmologist naturally desired to apply this new discovery as an aid in the diagnosis of foreign bodies in the eye. During the first year, owing to the imperfections of the apparatus, it seemed very doubtful whether the new method was practicable.

Van Duyse and Lewkowitsch believed that the orbital walls were impenetrable to the rays and devoted their experiments to the location of bodies in the anterior segment. Williams was the first to report a case of successful extraction from the vitreous of a metal which had been previously located by the roentgen ray. In May, 1897, Williams described a method of locating foreign bodies in the eye. The practicability and correctness of this method were shown by a case referred to Dr. William M. Sweet by Dr. William Thompson, where a foreign body was located in the vitreous, and subsequently removed, with preservation of the eyeball. The following year, 1898, Dr. Sweet presented a second paper on this same subject describing his methods in greater detail and giving an account of eight cases in which it had been used. At this time the plate holder and the two small metallic indicators were attached to the patient's head. The method was gradually developed, the next step being the attachment of the plate holder and metallic indicators to a board with the patient in a recumbent position.

In 1909, Dr. Sweet brought out the simplified and perfected instrument which is now so universally used. There is perhaps no more precise method where roentgen rays are used for a specific purpose than the one devised by Dr. Sweet. It is very accurate, and no one can calculate the value to mankind of the wonderful instrument which bears his name. The mathematical trend of his mind produced an aid in diagnosis which has saved the eyesight of many, many patients. Dr. Sweet also devised a very interesting forceps for the removal of nonmagnetizable metals, such as copper. The principle of this forceps was that when the tips of the forceps blades were closed upon the metal, a weak electric circuit would be completed and the fact that the forceps were closing on the metal would be indicated by a small delicate galvanometer placed in the electric circuit.

In considering the teachers of roentgenology during the formative period, the name of Baetjer naturally comes among the first. Baetjer's work as an exponent of the principles of roentgen diagnosis is entitled to the greatest praise.

Dr. Baetjer was a native of Virginia and became interested in roentgen-ray work while he was a student in the undergraduate department of Johns Hopkins University, where he graduated with an A.B. degree in 1897, receiving his medical degree in 1901. At this time the roentgen-ray work in Johns Hopkins Hospital had been under the direction of Dr. Harvey Cushing, and Dr. Richard Rand had charge of it as surgical interne.

In the Fall of 1901, Dr. Baetjer took active charge of this department and it was made a subdivision of general surgery. Since then he has been most active as a teacher as well as a philosophical student of clinical roentgenology. Due to his early roentgenoscopic work, he has suffered severely, but through it all has retained a cheerfulness which those less afflicted might well emulate.

Dr. Baetjer's first publication was in 1904 in collaboration with Dr. C. R. Bardeen, a paper entitled, "The Inhibitive Action of the Roentgen Rays on Regeneration in Planarians," *Journal of Experimental Zoology*. In 1905 he published in the *Johns Hopkins Hospital Bulletin* an article on "Thoracic Aneurysms." In 1906, another publication in the same journal on "The Use of the X-Ray in the Diagnosis of

Renal and Ureteral Calculi." The same year there followed "The X-Ray Diagnosis of Thoracic Aneurysms," also published in the *Johns Hopkins Hospital Bulletin*.

A large number of valuable contributions have appeared from the pen of Dr. Baetjer, as well as those articles in which he collaborated with others. The book of Baetjer and Waters on "Injuries and Diseases of the Bones and Joints" is found in every roentgen-ray library, and is both a textbook for pupils and a reference volume for students. It will be noted that Dr. Baetjer's publications are principally along the line of roentgen diagnosis.

In running over in one's mind the names of those who worked during the first decade of roentgenology in America, the name of Caldwell is almost preëminent. To those who had the privilege of an intimate acquaintance with Dr. Caldwell—and his friends were many—the memories invoked by that name are certainly vivid. Dr. Caldwell graduated in the West and came to New York City, where he was employed by the American Telephone Company, but soon devoted all his time to roentgen-ray studies. Caldwell was probably the ideal roentgenologist from the technical standpoint. His thoughts in his working moments were devoted to the problem of doing better roentgen-ray work and the development of adjuvants which would make his work more precise and useful. To this end, he devoted time and energy maintaining an elaborately equipped workshop operated by a skilled artisan.

In this brief paper, we will have to content ourselves with his work prior to the year 1905. Of the important publications, there appeared in the *Electrical Review* of New York, in 1899, an article entitled "A New Liquid Interrupter." This was a simple electrolytic interrupter having for its basic principle a porcelain diaphragm with a small opening to permit the passage of the current from one electrode to another. The same year there was a discussion of the liquid interrupter by Prof. Thompson, Caldwell and others. The publication just mentioned called forth a commendatory article by Dr. Charles C. Child, entitled, "Some Experiments with the Caldwell Interrupter," in the *Electrical Review* of London in 1899. In 1901 Caldwell published an article entitled, "A New Method of Obtaining Stereoscopic Effects in the Fluoroscope." This was published also in the *Electrical Review*. Perhaps the most important short article from his pen was "Skiagraphy of the Accessory Sinuses of the Nose"—*American Quarterly of Roentgenology*, 1906.

The most lengthy contribution which Dr. Caldwell made was the volume which he published in 1903 in collaboration with Dr. William Allen Pusey entitled, "The Practical Application of the Roentgen Rays in Therapeutics and Diagnosis." The first edition was speedily exhausted, and a second edition was brought out in 1904. Caldwell's name appears on the title page as Eugene Wilson Caldwell, B.S., but in 1905 he obtained his medical degree from the University and Bellevue Medical College. He was the first director of the Gibbs Memorial Laboratory. His first diagnostic work was done in a small room located in the rear of a drug store. He was greatly interested in the development of the stereoscope and devised the prism type which bears his name.

In his work he was very precise, and constructed a roentgenographic stand which rigidly maintained a fixed position of the tube with regard to the photographic plate. By making use of the tube underneath the table and the fluoroscope on the top, he was able to survey the area which he examined and also to determine the quality of the rays for the necessary penetration with a maximum contrast. His great delight was to discuss the problems of *x*-ray work with those who were interested in the same line, and his enthusiastic discussions often robbed him of much of his sleep. He gave very freely of his knowledge to those whom he thought would be appreciative. He became very much interested in the direct photography of the fluorescent screen and also in the problem of stereoscopic roentgenoscopy, toward the solution of which he contributed much of his time.

The fact that after his death the American Roentgen Ray Society established the annual Caldwell Lecture is perhaps the

best evidence of the respect and affection in which his memory is held.

An important factor in the development of American roentgenology was the establishment of the Edward Gibbs Memorial Laboratory. This was given by Mrs. Gibbs as a memorial to her husband. She spoke to Dr. Reginald Sayre concerning a suitable memorial and she mentioned that she had thought of establishing an *x*-ray laboratory. Dr. Sayre endorsed the idea, and the laboratory was established as a part of the Out-Patient Department of the New York University Medical School.

While the Laboratory was established by the widow of Edward Gibbs, it was later maintained through the generosity of his daughter, Mrs. Charles S. Sherrill. At first the laboratory was given an annual sum, but finally in 1923, an endowment was made to New York University by Mrs. Charles S. Sherrill, the income from which is sufficient to maintain the laboratory.

The first director of the Edward N. Gibbs Memorial X-Ray Laboratory was Dr. Eugene W. Caldwell, who established the laboratory and served as its director until his resignation in 1910. On his resignation, Dr. Leon T. LeWald was appointed director, which position he maintains at the present time.

The coming generation of roentgenologists should honor the donor of this memorial laboratory for her generosity in providing aid for the development of the new science while it was still in the formative period.

Among the early workers in roentgen therapy we would mention Dr. Ennion G. Williams of Richmond, Virginia. Dr. Williams subsequently relinquished a rapidly growing roentgen practice and entered the field of preventive medicine, in which as a health officer he had achieved great success. Dr. Williams' written communications were of importance. In 1903, before the Southern Surgical and Gynecological Association, he presented a paper with the title, "The Regulation of the Duration and Exposure and the Distance from the Tube in X-Ray Therapy." This article was particularly valuable because it called attention to the fact that in treating deep-seated malignancies the tube should be at a greater distance from the patient than when one is treating superficial areas. In 1905, before the Medical Society of Virginia he read a paper entitled, "A Few Remarks on the Principles Governing Roentgen Therapy." In this paper, he discussed the probable physiological action of the rays upon the tissues and their influence upon pathologic organs. Roentgen therapy certainly lost one of its most promising students when Dr. Williams turned his professional efforts to public health.

Dr. Alfred Gray of Richmond began his *x*-ray work in 1902 in connection with the department of physiology and medical physics at the University College of Medicine. The *x*-ray work in the hospital at that time in the College Hospital was done with a twelve-plate static machine. Dr. Gray relates that as it was the duty of the hospital orderly to turn the crank of this twelve-plate machine, he often found it quite difficult to locate an orderly. The first paper by Dr. Gray was entitled, "The Present Status of Roentgen Ray as an Agent in the Report of Cases." This was read before the Tri-State Medical Association at its meeting in Danville in 1904. In this paper Dr. Gray presented a series of thirteen cases of epithelioma of which eight were entirely cured, three received some other treatment, one case moved away and one was discharged with some benefit.

In 1905, Dr. Gray presented a paper before the Richmond Academy of Medicine and Surgery entitled, "Some Practical Results in X-Ray Therapy." These papers were the first of the many publications which Dr. Gray has presented both in diagnosis and therapy. His work has always been an inspiration to the Southern workers, who have always found him most helpful.

One of the prominent pioneers in roentgenology in Canada was the late Dr. G. T. Girdwood, president of the American Roentgen Ray Society in 1902. It was the writer's privilege to see recently the early *x*-ray tubes which were used by Dr. Girdwood in 1896 and 1897. Dr. Girdwood's daughter showed me some of the early

plates which were made by Dr. Girdwood. His work began with a small static machine which was turned by hand, and the necessary exposure for an *x*-ray of the hand was thirty-seven minutes. Antedating this exposure of the hand were numerous experimental plates of metallic objects in non-metallic boxes. There is still preserved a roentgenogram of the foot taken on October 27, 1897, and its excellence is sufficient to rank it with many more modern attempts.

Most of these early plates were taken in Dr. Girdwood's laboratory at McGill University. For many years Dr. Girdwood was radiographer of the Royal Victoria Hospital, making the first roentgenogram there in September, 1901. The address as President of the American Roentgen Ray Society, which Dr. Girdwood gave in 1902, was a candid statement of the uses to which the *x*-ray had been put up to that time, and contained also a discussion of the various explanations of the essential nature of the roentgen ray. The historical relics in the possession of the Girdwood family are becoming more valuable every year and should be housed in permanent fashion in some national museum.

To Dr. Weston A. Price of Cleveland is most willingly accorded the credit of considerable of the work done in the development of the use of the roentgen ray in dentistry. He devised a special triple coated, heavy film for dental roentgenography which was extremely sensitive and did much to simplify the technique. Both the roentgen-ray journals and the dental journals contain many articles describing both the improvements in the technique and authoritative contributions on the interpretation of dental roentgenograms. The whole roentgen-ray profession, however, owes a great debt of gratitude to Dr. Price because he was the one who developed the opaque insulating cloth from which our protective gloves, aprons, tube shields, etc., are made. This was patented by Dr. Price, but the formula and the patents were at once given to the public so that he never realized any financial returns. The invention of this protective material has undoubtedly been one of the most important factors in protecting us from the harmful effects of the roentgen ray from which so many of the pioneers suffered.

In this hasty survey of the outstanding figures in American roentgenology, we would like to make more than a passing mention of Dr. William H. Stewart of New York, whose pioneer work on pneumoperitoneum led to a new method of abdominal diagnosis, and his work on skull fractures is a most valuable monograph.

Dr. Lewis Gregory Cole made his first exposure with the *x*-ray in 1899 at Roosevelt Hospital. This exposure, with a water-cooled Müller tube, was made without putting water into the tube until after it was used, and Dr. Cole writes, "The tube was never used again."

In 1900 Dr. Weir, then surgical chief at Roosevelt Hospital, referred to Dr. Cole a woman who had been shot through the eye with a 22 calibre bullet. The bullet was lodged at the base of the brain. Dr. Cole was able to localize this so that it was removed by Dr. Weir through a small trephine opening. This case was reported by Dr. Cole in 1901 and was his first contribution to roentgenologic literature.

About this time Dr. Cole constructed a metal tube at the lower end of which a small roentgenoscope could be inserted. This tube could be sterilized and with the roentgenoscope could be inserted into an incision over the kidney. The kidney could then be drawn up and observed roentgenoscopically, by which method a small stone in the kidney was removed in a case where palpation and needling had failed to reveal its location. This method was used several times and long antedates the present revival of the roentgenoscopic examination of the exposed kidney.

Dr. Cole adapted a Wehnelt interrupter to a rebuilt 12-inch coil with the primary shortened, and by studying the frequency of the interruptions as indicated by the musical note of the interrupter, he was able to greatly improve his diagnostic work.

In 1903 Dr. Cole noticed shadows in some of the chests of the patients whom he had examined for the ribs and spine. He suspected that these shadows were of

pulmonary origin and he decided to verify the same, but was unable to obtain any patients for chest examinations even if no fee were charged. Finally Dr. Austin Riggs, an assistant at the Vanderbilt Clinic, did send him some cases but made him promise that he would not tell from whom they came. As Dr. Cole wished further verification of his studies on the chest, he asked one of the pathologists to furnish him some lungs of tuberculous cases. This, the pathologist flatly refused to do and further added that he would do all in his power to prevent Dr. Cole from obtaining such material, as he regarded the *x*-ray as a type of charlatanism. An interesting sequence of this episode was the fact that the pathologist afterwards died of tuberculosis, a striking example of the irony of fate.

It is most extraordinary to look back on the incredulity and ridicule with which Williams' work on the chest was received in Boston, and the difficulties which Dr. Cole in a similar fashion encountered with the New York profession. It is further a source of regret to recollect that the same conservatism made the profession slow to accept the stethoscope and the clinical thermometer. In the introduction to the English translation of Laennec's work on auscultation, the translator writes, "While the stethoscope will probably come into use in Naval hospitals, still it would never be used in general practice because the spectacle of a grave physician listening to a patient's chest would be so ludicrous as to prevent its use."

Dr. Cole writes somewhat in the same fashion as Dr. Crane, "I shall always look upon those early days, when the art or science of making a good roentgenogram was an important factor in the science of roentgenology, as the most brilliant and interesting period in the development of this specialty and I believe that we could now, with profit, spend much more time on the art and science of making roentgenograms."

Dr. A. W. Crane of Kalamazoo began his practical work in March, 1897, with a 12-inch coil equipped with a hammer type of break. The current was supplied from a homemade bichromate battery of six cells. This same year Dr. Crane secured a 16 × 18 inch platino-barium-cyanide screen so that he could examine the entire chest. This, he mounted in a picture frame with a heavy plate glass front, which while not so efficient as our present day lead glass, still afforded a great deal of protection. This screen retained its brilliancy for many years, owing to the fact that it was hermetically sealed in its frame with paraffin. Dr. Crane also employed a tube box lined with glass which evidently cut off a good deal of the excess and harmful ray.

In August, 1898, Dr. Crane read a paper on "The X-Ray Examination of the Chest," before the Kalamazoo Academy of Medicine. This paper was re-written and published in 1899 in the *Philadelphia Medical Journal* under the title of "Skiascopy of the Respiratory Organs." In 1899, Dr. Crane devised an electrolytic or so-called "Wehnelt" interrupter for use with the alternating current. This was probably the first electrolytic interrupter made for operating an *x*-ray coil on the alternating current. Caldwell, in his book in 1903, gives a description of this type, and mentions that it was devised by Dr. Crane.

As his original coil was built for a 15-volt direct current, it soon broke down, but Dr. Crane re-wound it himself and immersed the coil in transformer oil after which it worked more efficiently for many years.

In 1900, Dr. Crane published the "Skiameter" in the *Philadelphia Medical Journal*. This was an epoch-making publication correlating roentgen findings with the physical signs of chest pathology. It is an article which should be frequently re-read by all students of pulmonary roentgenology. Dr. Crane's subsequent publications have been most valuable. I cannot refrain from quoting from a letter from Dr. Crane in which he said, "I did not then (1905) appreciate as I do now the inestimable privilege of helping to develop one of the greatest discoveries of all time and to take part in the greatest revolution that the art of diagnosis has ever yet undergone, and to have lived in the grand period of medical history, namely, that

of bacteriology, the *x*-ray and aseptic surgery."

In considering the contributions of the first decade of roentgenology, especially those which were to be of such great importance in the adaptation of the work to the field of internal medicine, one must assign a prominent place to the pioneer work of Dr. Henry Hulst of Grand Rapids, Michigan.

In 1902, at the meeting of the American Roentgen Ray Society in Chicago, Dr. Hulst exhibited roentgenograms of the lungs taken with 1, $^1/_2$, and $^1/_4$ seconds' exposure. When one considers that these very rapid exposures were made without the use of intensifying screens, the importance of Dr. Hulst's work is the more impressive. This was followed in 1903 by a paper read in Philadelphia on "Skiagraphy of the Chest," describing his technique in detail. These two presentations must be regarded as very important factors in arousing the attention of internists to the possibilities of the roentgen ray in the diagnosis of diseases of the chest.

In 1904, Dr. Hulst presented a paper, "The Compression Cylinder in Skiagraphing Calculi," demonstrating a modification of the compression cylinder of Albers-Schönberg of Hamburg. This was an important article in that it was an early contribution to the technique of the suppression of scattered radiation, which up to that time had been such a barrier in the study of the heavier parts of the body. Another epoch-making paper which Dr. Hulst wrote was the one presented in 1905 at the Baltimore meeting of the American Roentgen Ray Society; the subject was "Roentgenography in Diseases of the Stomach and Intestines." In these studies of the alimentary tract, Dr. Hulst presented most remarkable roentgenograms made with an average exposure of one second, carrying out the same line of technique which he had formerly presented in studies of the chest. These studies attracted considerable attention, even from the anatomists, and he was invited to furnish to the anatomical department of the University of Pennsylvania a series of roentgenograms of the alimentary tract, demonstrating the relative positions assumed by the stomach and intestines in various positions of the subject. This must also be regarded as valuable pioneer work, especially when we consider that now many anatomical departments regularly use the roentgen ray in the study of gross anatomy.

The importance of Dr. Hulst's work is certainly accentuated when one remembers that before this time the usual chest plates showed so much blurring from respiratory motion that the minor details of early lesions were quite lost and only the grosser evidences of pathology could be made out.

As a native of Michigan, the writer feels great pride in calling attention to this work of Dr. Hulst and Dr. Crane in the development of the importance of roentgenology as a diagnostic aid in internal medicine. The early investigations of these two men and their studies of technique and interpretation certainly did much to arouse the interest of the medical profession as to the importance of roentgen-ray studies of the thorax and abdomen, studies which did much to develop their present everyday use.

Through the kindness of Dr. Harry Dachtler, of whom I made inquiry as to the early history of the American Roentgen Ray Society, we learn that there was a preliminary meeting held in St. Louis on March 26, 1900, at the office of the *American X-Ray Journal*, with New York, Ohio, Illinois, Missouri, Iowa, Nebraska, Kentucky, California and Texas represented. Dr. Heber Robarts was elected president, and Dr. Rudis-Jicinsky, secretary. A constitution was adopted, written in most part by Dr. Weston A. Price. The name of the society was "The Roentgen Society of the United States." New York City was selected as the place of the first regular meeting which was held December 13 and 14, 1900, in the Grand Central Palace with Dr. Monnell as chairman of the committee of arrangements. The president's address was published in the December number of the "*American X-Ray Journal*," and the proceedings in the January, 1901, number of the same publication. The second annual meeting was held at Buffalo at the time of the Exposition.

The writer has very pleasant recollections of his acquaintance with Mr. W. C. Fuchs, whose office was in the Schiller Building in Chicago. Mr. Fuchs was originally an electrical engineer and his electrical knowledge helped him very much from the technical standpoint. His work was done with an induction coil and a mechanical interrupter. On entering his laboratory, one was attracted first of all by the number of tubes which he had hanging on the wall. He pointed out to me that one particular tube was used for making *x*-rays of the hip, another for *x*-rays of the hand, and so on with each of the more important parts of the body. He would only use a particular tube for a particular purpose and in this way avoided the difficulties of attempting to adapt the vacuum of the tube to the particular type of penetration needed. As far as is known, he was the first one in America to make a successful roentgenogram of the hip joint.

At the Buffalo meeting of the American Roentgen Ray Society the writer met Mr. Fuchs and a young man who was stopping at the same hotel. At this time there was considerable excitement over the fact that President McKinley had been shot and the doctors, who were in charge of the case, were divided in their opinion as to whether the roentgen ray should be used. Before the meeting had ended, Mr. Fuchs confided in me that at the request of one of the surgeons he had his *x*-ray coil sent down from Chicago and that it was stored in the basement of his hotel, ready for use. I then learned that the young man accompanying Mr. Fuchs was a Chicago reporter. Mr. Fuchs later informed me that the physicians on consultation had decided that the *x*-ray should not be employed.

Two or three years later an article appeared in one of the Eastern medical journals describing a new way of making *x*-rays. The new way consisted of having one tube above the patient and one tube at the side of the patient. Meeting Mr. Fuchs a little later, I remarked about the improbability of such a procedure and he then informed me that when the writer of the paper had been in his office some little time before looking for what information he might pick up, Mr. Fuchs told him that he had devised a new method using two tubes. Mr. Fuchs then added, "The fool swallowed the story, wrote it up as his own idea and sent it in to the Eastern medical journal, which promptly published it as a leading article."

He showed me the first *x*-ray stereoscope which I had ever seen and which had been made for him by a carpenter. He aroused in me a fondness for stereoscopic work from which I have never recovered.

Mr. Fuchs was one of the first to really show gallstones on a roentgen plate, and I remember meeting Dr. Christian Fenger who came into Mr. Fuchs' office to show the gallstones which he had just removed, the number of which corresponded to the number shown on the plate.

In spite of the fact that Mr. Fuchs was not a physician, he did a vast amount of useful roentgen-ray work, and the technical excellence of his plates was a great stimulus to those who had the opportunity of seeing them.

In closing, the writer feels the burden of having dealt very inadequately with this presentation, crowded as it is with sins of omission which are all too obvious. As members of the American medical profession each of us feels proud of the important place which American roentgenology has assumed in the history of medicine, especially when we realize that in no other country in the world is the help which the roentgen ray can afford so universally accessible to the poor as well as to the rich.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL (*76 Fifth Avenue, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Twenty-ninth annual meeting, Hotel President, Kansas City, Mo., Sept. 25–28, 1928.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Portland, Oregon, 1929.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, Oregon, 1929.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Fourteenth annual session, Chicago, Ill., Dec. 3–7, 1928.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.
Next annual meeting, Asheville, N. C., Nov. 12–15, 1928.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, 2033 Park Ave.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. Carl S. Oakman, Muncie, Indiana.
Annual meeting each February 22 in Indianapolis. Next meeting in Indianapolis, February, 1929.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. John D. Camp, Massachusetts General Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Annual meeting, Galveston, Texas, 1928.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting Oct. 17, 1928.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, Sept. 16–21, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.
Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

REPORT OF THE STANDARDIZATION COMMITTEE OF THE AMERICAN RADIUM SOCIETY

PRESENTED AT THE 13th ANNUAL MEETING HELD IN MINNEAPOLIS JUNE 11–12, 1928

1. *Dosage Data.* The committee wishes to call attention to a previous report in which the various dosage factors of a radium treatment were enumerated and discussed.* It is important that the recommendations there made as to the specification of dosage factors be followed by those who write papers on radium therapy. The committee feels that the value of many contributions to the literature in this field is greatly reduced by the inadvertent omission of important data

* AM. J. ROENTGENOL. & RAD. THERAPY, 1926, XVI, 57–60.

which is essential for the evaluation or comparison of dosage. In some form or other the following data should always be given: (1) Location of tumor, (2) Size of tumor, (3) Depth of tumor, (4) Strength of radioactive source, (5) Distribution of radioactive source, (6) Total filtration, (7) Distance or spacing, (8) Duration of irradiation. Pertinent details may be found in the original report.

2. *Filtration.* During the last few years the trend of radium therapy has been towards the elimination of beta radiation as a therapeutic agent, *except for the treatment of certain superficial lesions.* It is generally recognized now that gamma ray applicators should be used for the treatment of lesions which extend to a depth or distance from the radium beyond a few millimeters. In any radium treatment the dose delivered to the tissues must be so adjusted as to be sufficient at the farthest point of the involved region. Beta rays, being largely absorbed by a few millimeters of tissue, contribute little to the effect produced at greater depths; but of necessity cause over-irradiation of the intervening tissue. On the other hand, beta radiation is well suited to the treatment of superficial lesions, especially when they are not malignant, because the effect is more local and the underlying normal tissues are not subjected to large doses of radiation.

When the radiologist wishes to employ only gamma radiation, he should use a primary filter of 2 mm. of brass and a secondary filter of 2 mm. of pure gum rubber or an equivalent combination of other materials. Brass as a primary filter has the advantage that it produces little secondary radiation and should be used whenever distance or space permits. On the other hand, the same degree of filtration may be obtained by the use of denser metals of smaller thickness than 2 mm. The following table gives "equivalent" thicknesses of five different metals commonly employed in radium therapy. *Pure* gold, platinum, iridium and their alloys have practically the same absorbing power. Jeweler's gold (yellow, "green," "white," 14 and 18 kt., etc.) consists of gold alloyed with metals of lower atomic weight and density. Accordingly it is not as effective a filter as pure gold.

EQUIVALENT THICKNESSES OF DIFFERENT METALLIC FILTERS

Primary Filter Thickness in Mm.				Thickness of Rubber in Mm. as Secondary Filter for Each
Platinum or Gold	Lead	Silver	Brass	
0.2	0.47	0.51	0.76	1
0.3	0.63	0.71	1.02	1
0.4	0.74	0.88	1.30	2
0.5	0.86	1.10	2.00	2
0.75	1.30	.....	.....	3
1.00	2.10	.....	.....	4

The "equivalent" thicknesses given in the table are equivalent as regards the production of skin erythema by radium rays thus filtered, when the applicator is not very close to the skin. Nevertheless, they are approximately equivalent for all ordinary conditions of treatment. Since in practice it is difficult to obtain thicknesses identical with those specified it may be well to say that exact duplication is not necessary. Thus for practical purposes we may say that 0.5 mm. of platinum or gold is equivalent to 0.9 mm. of lead, 1.1 mm. of silver, and 2 mm. of brass when a secondary filter of 2 mm. of gum rubber is added to each. The combination of 0.5 mm. of silver, 1 mm. of brass and 2 mm. of rubber is also equivalent to the above. This is commonly employed in this country for gamma ray applicators. It may be pointed out here that a small variation in thickness in the lighter metals such as brass is not so important as a similar variation in the thickness of a platinum or gold filter. Furthermore small additional filtration beyond 2 mm. of brass or its equivalent has little influence on the amount of radiation passing through, since the easily absorbed beta rays have already been removed. On the other hand, there is a considerable difference between the filtering power of 0.2 and 0.3 mm. of platinum.

In the interstitial use of radioactive substances, both theory and experience have shown that in general beta radiation is undesirable. By virtue of its small penetrating power it contributes largely

to the tissue necrosis produced around the source and it adds but little to the dose at critical points in the tumor mass. These critical points are in the periphery of the tumor where the tissue is irradiated from one side only and midway between the radiating centers where the intensity of radiation is least. If the distance between adjacent sources is greater than one centimeter, which is apt to occur, there will be islands of tissue which receive very little beta radiation. Even when the spacing is less than one centimeter the intense necrosis produced in the neighborhood of each source by the beta radiation is very objectionable. Accordingly, it is suggested that platinum, gold or dense alloy needles be used for interstitial treatments. The filter thickness in such cases should be as large as possible without making the needle unduly large in diameter, for the particular lesion to be treated. In general, 0.3 to 0.4 mm. of platinum can be used. Steel or monel metal needles allow a large percentage of the beta radiation to pass through and therefore they do not conform to the present ideas of filtration to be of general utility.

The same reasons which have led to the more extensive use of heavily filtered needles, have caused radical changes in the buried radon technique. Glass tubes or seeds for permanent implantation have been superseded almost entirely by gold or platinum implants. The following table shows the relative amounts of necrosis produced by implants of different filtration ranging from 0.15 mm. of glass to 0.3 mm. of gold or platinum.

Radon Content, Mc.	Necrosis (Complete and Partial)					
	Glass Tube		0.2 Mm. Gold Tube		0.3 Mm. Gold Tube	
	Radius, Mm.	Volume, Per Cent	Radius, Mm.	Volume, Per Cent	Radius, Mm.	Volume, Per Cent
0.5	2.0	30	1.0	3.7	0.8	1.9
1.0	3.0	100	1.6	14.8	1.14	5.5
1.5	3.6	174	2.1	34.5	1.5	12.6
2.0	4.1	255	2.5	57.8	1.8	21.5
2.5	4.4	315	2.8	81.5	2.1	34.5
3.0	4.6	360	3.0	100.0	2.3	45.0
4.0	5.0	460	3.4	146.0	2.7	73.0
5.0	5.3	550	3.6	173.0	3.1	110.0
7.0	5.6	650	4.0	237.0	3.5	163.0
10.0	5.9	760	4.5	340.0	4.1	253.0

3. *Comparison of External Applicators.* Applicators, variously known as "packs," "trays," "plaques," etc., of many different shapes and sizes are used by different radiologists. The data tabulated below will be found useful for the comparison of doses administered with different gamma ray applicators having a filtration of 2 mm. of brass and 2 mm. of rubber or its equivalent (q.v.).

ERYTHEMA DOSES IN MILLIGRAM-HOURS FOR APPLICATORS WITH FILTERS OF 2 MM. OF BRASS AND 2 MM. OF RUBBER PLACED AT VARIOUS DISTANCES FROM THE SKIN

Distance, Cm.	*Circles*—Diameter					
	1 Cm.	2 Cm.	4 Cm.	6 Cm.	8 Cm.	10 Cm.
1.0	180	234	406	640	940	1,285
1.5	381	437	640	918	1,250	1,675
2.0	661	728	936	1,250	1,620	1,850
3.0	1,470	1,530	1,760	2,120	2,720	3,060
4.0	2,570	2,670	2,880	3,270	3,790	4,370
5.0	4,000	4,120	4,370	4,650	5,150	5,760
6.0	.....	5,760	6,000	6,550	6,860	7,580
7.5	.....	9,000	9,000	9,600	10,300	11,000
10.0	.....	16,000	16,000	16,000	18,000	18,000
	Squares—Length of Sides					
	1 Cm.	2 Cm.	4 Cm.	6 Cm.	8 Cm.	10 Cm.
1.0	190	252	439	686	1,000	1,385
1.5	386	465	686	986	1,600	1,780
2.0	670	762	1,000	1,350	1,760	2,250
3.0	1,485	1,530	1,870	2,250	2,720	3,350
4.0	2,620	2,670	3,070	3,600	4,000	4,650
5.0	4,000	4,240	4,500	4,970	5,540	6,260
6.0	.....	6,000	6,260	6,860	7,580	8,000
7.5	.....	9,000	9,600	10,300	11,000	12,000
10.0	.....	16,000	16,000	18,000	18,000	18,000
	Rectangles—Length of Sides					
	1 × 1.5 Cm.	2 × 3 Cm.	4 × 6 Cm.	6 × 9 Cm.	8 × 12 Cm.	10 × 15 Cm.
1.0	198	290	565	974	1,470	2,060
1.5	400	502	838	1,275	1,845	2,675
2.0	679	792	1,285	1,655	2,250	3,000
3.0	1,485	1,600	2,000	2,620	3,350	4,120
4.0	2,620	2,720	3,200	3,790	4,650	5,540
5.0	4,000	4,240	4,650	5,340	6,260	7,200
6.0	.....	6,000	6,260	7,200	8,000	9,000
7.5	.....	9,000	9,600	10,300	11,100	12,000
10.0	.....	16,000	16,000	18,000	18,000	18,000

It should be noted that when flat applicators are made up of tubes or needles they should be evenly spaced and the radiating surface of the applicator should be considered as only slightly larger (about 10 per cent) than the area actually covered by the tubes or needles. The distance of application should be measured from the center of the radioactive source to the skin. The milligram-hour doses given in

the table are those required to produce a faint erythema on the skin of the average patient. It is, perhaps, superfluous to add that they are not therapeutic doses, which might be considerably smaller or larger depending on the requirements of the case.

4. *Therapeutic Dosage.* The question of adequate dosage for the treatment of certain conditions falling within the province of radium therapy, has been considered carefully by your committee. It has been decided that it is inadvisable at this time to recommend even minimum and maximum doses for well defined lesions. The principal reasons for this decision are as follows: (1) Each patient presents an individual problem involving many factors which cannot always be specified unequivocally. (2) Radiation doses vary not only with the nature of the disease, its location, etc., but also with the method of treatment employed. (3) There are several well established methods of treatment yielding good results, but there is no uniformity in dosage. Accordingly dosage and technique are inseparable. (4) Radium treatments are often combined with other therapeutic measures, and doses depend also on the particular procedure adopted.

In view of these considerations your committee wishes to suggest the following plan:

(a) That the Standardization Committee prepare a condensed description of the technique employed in each important radium clinic in this country and abroad, the material to be obtained from published reports, and when possible through personal contacts.

(b) That a reasonably uniform method of classification be worked out in order that comparison of technique and dosage used in different clinics may be made.

(c) That a separate report be made for each region of the body to facilitate comparison of methods and dosage (uterus, mouth, breast, etc.).

5. Your committee feels that the value of such reports would be greatly enhanced if they were available for ready reference. For this purpose two alternative plans may be suggested. (a) The society could obtain reprints of each report and distribute them at cost to the members. (b) Reports could be printed in loose-leaf form to fit a small standard note book.

The loose-leaf plan has certain obvious advantages. If it is adopted, the notebook could be started in the near future by printing the previous Standardization Committee Report on dosage factors (already referred to) and adding new reports when ready. Technique and dosage reports for different clinics could be brought up to date from time to time and each radiologist could use part of the book for his own annotations.

The above general suggestions are submitted to the society for consideration, and it is urged that they be thoroughly discussed. Details can be better brought out in the course of the discussion. If the loose-leaf plan is adopted, some official action should be taken in regard to the printing and distribution of pamphlets to the members, for the guidance of the next committee.

Respectfully submitted by the
Standardization Committee
G. Failla, D.Sc., Chairman
Henry J. Ullmann, M.D.
Robert B. Greenough, M.D.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A SAFE AND AUTOMATICALLY CONTROLLED FILM TUNNEL INTO THE DARK ROOM*

BY WILLIAM T. HILL, AND STAFFORD L. WARREN, M.D.

ROCHESTER, NEW YORK

A SIMPLE and safe passage for film cassettes and holders from roentgenographic rooms into the dark room is a necessity in almost every clinic. Freedom from light leakage into the dark room from an accidentally opened door during the exchange of exposed for unexposed film holders or cassettes is often difficult to obtain.

The mechanism here described can be made and installed cheaply and readily with simple tools and will work satisfactorily, provided heavy enough parts are used. This is essential as the passage is subjected to continuous use and abuse.

Any size tunnel can be built to fit local requirements. This film passage or tunnel is nothing more than a box with open ends, built through the dark room wall with inside dimensions of 19 × 24 in. (Fig. 1).

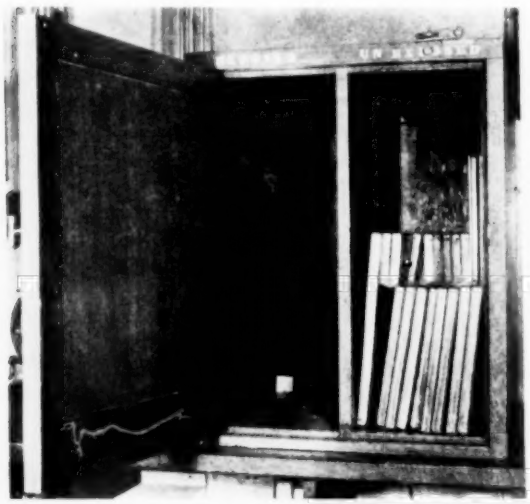

FIG. 1. Film cassette tunnel from dark room side with door wide open to show division. The back of the tunnel is closed by a lead armoured door (see Fig. 2) opening into the roentgenographic room.

FIG. 2. Armoured door opening from roentgenographic room into the cassette tunnel.

This space is divided in half by a partition which allows exposed films to be placed on

* From the Department of Radiology of the Strong Memorial Hospital and the University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

one side, and freshly loaded, unexposed films to be stored on the other. The tunnel can be built at an angle with the wall and yet be operated by the same principle described here.

Each end is closed by a simple cupboard door swinging outward on hinges and fastened by a simple cupboard latch, not by a spring catch. Both doors are hinged from the same side. One door can be on each end of the rod with nuts and lock washers, soldering, riveting, or any other suitable method. These cross arms are fixed at right angles to each other. Their relationship, clockwise or counter clockwise to each other, is determined by the side of the tunnel upon which the doors are hinged. These cross arms are long enough when in the "down" position to overlap the door, when closed, about $1\frac{1}{2}$

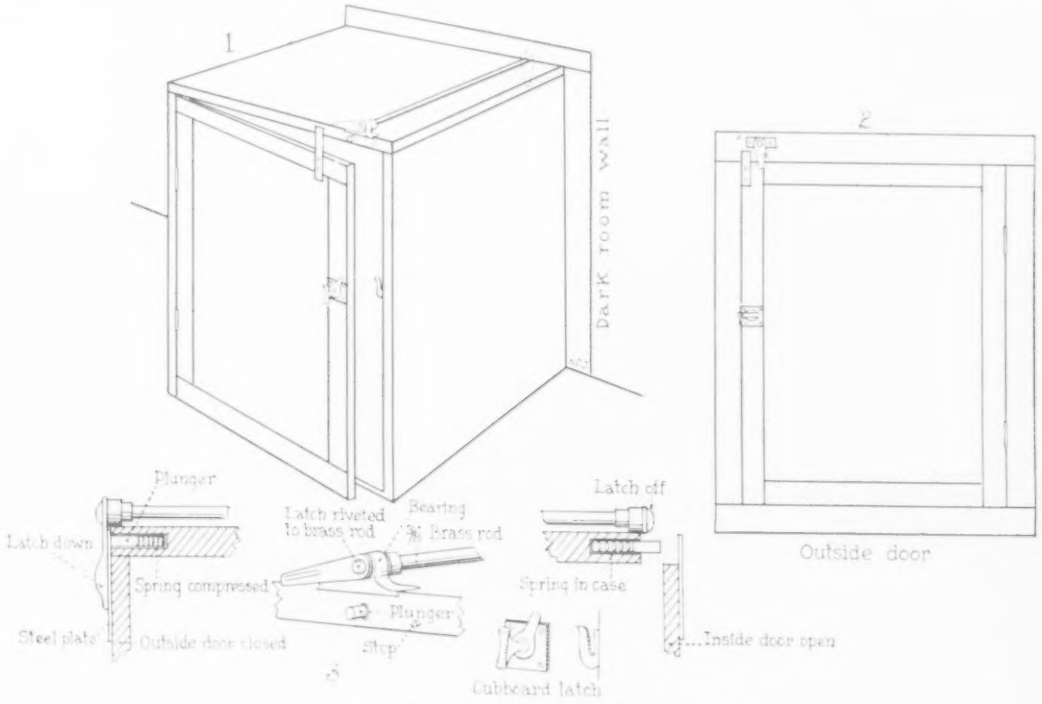

FIG. 3. Cassette tunnel automatic control device.

suitably armoured with lead, when necessary, to conform with the general protection afforded the dark room from radiation, and both doors are made to close light-tight by proper felt edging, etc. (Fig. 2).

The automatic control device is installed in the upper, outward corners of the doors. This device consists of a rod of $\frac{3}{8}$ in. cold-rolled steel or hard brass, passing the full length of the tunnel through the casing above the tunnel doors. This is supported at either end by a cross piece of $\frac{1}{4}$ in. brass plate with a hole large enough to allow the rod to turn freely. This cross piece or bearing is screwed to the casing. A cross arm or latch of brass or steel, about $3 \times \frac{3}{4} \times \frac{1}{4}$ in., is fastened firmly in. with a clearance of about $\frac{1}{16}$ of an inch.

In the door casing about 1 in. within the arc described by the cross arm, a $\frac{1}{2}$ in. hole 3 in. deep is bored. Into this is placed a spring plunger for preventing the descent of the cross arm when the door is open. This consists of a 3 in. length of $\frac{1}{2}$ in. brass tubing, a brass rod $1\frac{1}{2}$ in. in length as a plunger, and a 2 in. length of spring, both fitting inside the tubing fairly snugly. The plunger is soldered to the spring and the latter to the inside of one end of the tubing so that the plunger projects about three-fourths to an inch from the end of the tube. On pressure, the plunger retreats flush within the tubing.

A strip of stiff or tempered $\frac{1}{8}$ in. steel plate, 1 × 4 in., is mounted on the door so that enough projects above the door to press upon the plunger in the door casing when the door is closed. This strip is set into the door and casing a little so that the cross arm can swing down over it to the vertical position and so prevent the opening of the door. Two small pins or screw heads in the door casing limit the excursion of the cross arms to the required arc of 45° (Fig. 3).

To use the film tunnel, the cross arm is elevated from the vertical to the horizontal position. This depresses the opposite cross arm to the vertical position and prevents the opening of the other door. As the door is unlatched and pulled open, the plunger comes out from the casing and prevents anyone on the other side from moving the cross arm downward in order to open the opposite door. Until the door is firmly closed and latched, the cross arm cannot descend to allow the opposite door to open. Spring latches would ordinarily work, but in dry weather, shrinkage is apt to cause faulty alignment and failure of the door to latch.

By this mechanism, positive latching becomes a habit. One hand is sufficient to operate the door. One knows immediately whether the other door is open or closed. The wearing parts are negligible. The size and shape of the tunnel built this way is sufficient to store quite a quantity of cassettes and film holders of various sizes. These can be inspected in full daylight without danger to films on the loading benches next to the tunnel in the dark room. The mechanism can be made with material and equipment available in any hospital shop no matter how small.

A SIMPLE AND RAPID FILM DRIER*

BY STAFFORD L. WARREN, M.D.

ROCHESTER, NEW YORK

THE building of a cheap and efficient film drier is a vexing problem. There is usually little space allotted or available for the purpose. The space and location must often determine the shape and capacity of driers built to fill the usual needs. As space is precious and labor saving essential, a drier should be connected with the dark room and, at the same time, should give ready access to the dry films from the outside without interrupting the dark room work. A good drier was described by Doub,[1] but we have had to make certain changes in his design to meet a greater capacity and special needs which that drier did not afford. The drier described here will easily dry five hundred films a day and could be pushed to one hundred films an hour including time necessary for loading and unloading this number. Its chief good feature from our standpoint is the drying of a few films in from three to ten minutes. This makes it possible to dry all emergency films before they are sent out of the department. Mutilated films are thus avoided, and the dried films are easier to handle in the emergency.

In our particular plan the drier has been placed against one wall of the dark room, at the back of the developing tanks (Fig. 1). This makes it especially easy to drop the wet films from the wash tank into the drying racks and shove the racks into the drier through a vertically sliding door. The drier box is made of white wood with the top 2 ft., 8 in. from the floor. In the front there are three double doors opening toward the viewing room. These doors have simple lever latches which hold them tight in spite of shrinkage or swelling from variations in humidity or changes in

[1] Doub, H. B. A satisfactory film dryer. AM. J. ROENTGENOL. & RAD. THERAPY, 1924, xii, 81–83.

* From the Department of Radiology of the Strong Memorial Hospital and the University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.

air pressure from within. The floor of the box has a pitch of $1\frac{1}{2}$ in. in 10 ft. and has a covering of zinc. A small drain is advisable as the frames are placed in the drier while the films are dripping wet (Fig. 2).

These frames hold fifteen film hangers of any size, spaced $1\frac{1}{2}$ in. apart. Any number can be used corresponding to the width of the drier box. The frames are made of hard wood, braced at the corners with brass angles and brass strips. There are ball bearing ball rollers on each corner which make easy the handling of the frames on the floor or in the drier (Fig. 3).

The film hangers (Eastman Kodak type) fit readily in $\frac{3}{8}$ in. grooves cut $\frac{3}{8}$ in. deep in the top and side guide pieces of the frame. The slots in the guides, about one-third of the way down from the top, catch and hold the film hangers firmly, parallel to each other. This prevents swaying in the breeze made by the blower and contact of the films while wet. Its high position also allows all sizes to be used indiscriminately; i.e., a $5 \times 7''$ can be placed next to a $14 \times 17''$ film. Dental film hangers can be hung from the unused portion of the cross piece of the smaller sizes; i.e., $5 \times 7''$, etc. or at the ends of the wooden frame. Thus all the films are held firmly parallel to the stream of warm air blown through the drier.

The heating element consists of eighteen (General Electric Co.) 100 watt heating elements placed in two banks in front of the fan. They are connected (in parallel) so that half or all can be run alone (Fig. 4). The elements, being flat, make excellent vanes so that they can be used to deflect the warm air currents to the sides of the drier box and thus equalize the distribution of heat and pressure. A bumper in front of the bank of heating elements locates the position of the foremost drying frame or rack. The others are pushed down against this one in succession from the vertically sliding door in the dark room wall.

Asbestos is placed expeditiously on the wooden walls near the heating elements for safety from fire. With the motor connected to the heating elements so that they cannot be turned on without the fan, a pilot light is unnecessary. With suitable

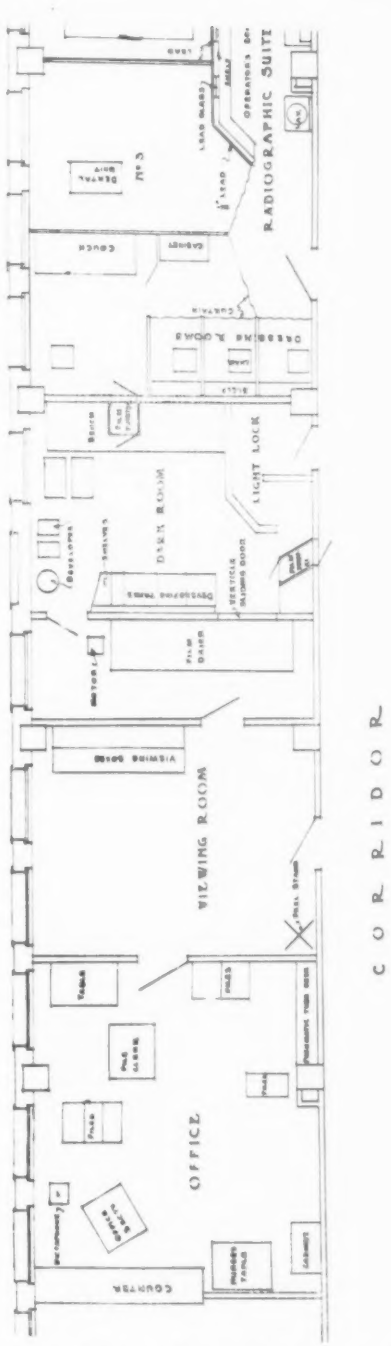

FIG. 1. Plan showing relation of drier to dark room, viewing room and files.

fan capacity, heat can be supplied in large amounts. The maximum, without damage to the films, depends upon the volume of air, temperature, and humidity. With dry, cold, winter air (30°F.) and the

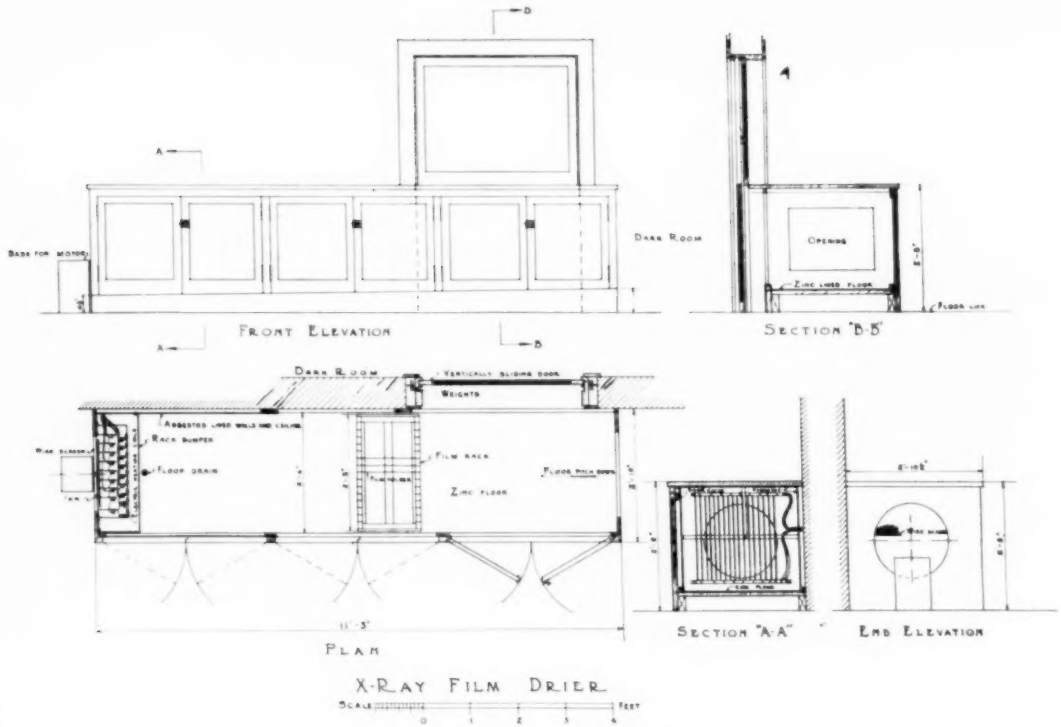

FIG. 2. Film drier showing details.

fan sending from 1500 to 2000 cubic feet a minute through the drier, 1800 watts are used, and the air comes out barely warm. In warmer weather, only 900 watts are used, and in summer the fan alone is sufficient. Air, driven by a fan with a rated capacity of 2100 cubic feet per minute against the 1800 watt heater, does not allow the heaters to become perceptibly warm, although the energy they give off is immediately noticeable if they are on without the fan. If the fan is run without them, the drying time is increased materially.

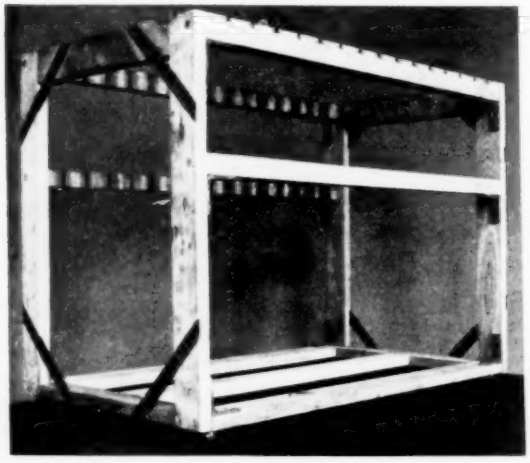

FIG. 3. Film hanger holder or rack—holding fifteen films.

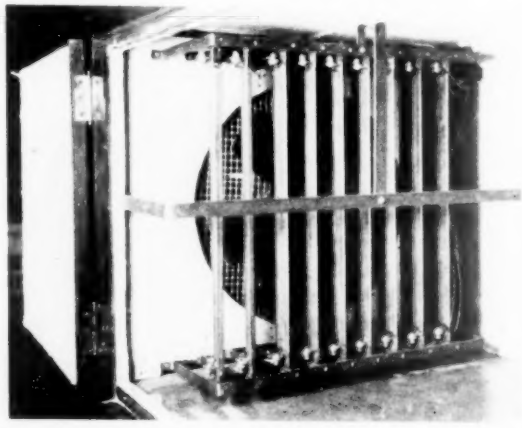

FIG. 4. Arrangement of heating element and fan inside of box.

The fan, a variable high speed, ventilating blade type, is mounted solidly on a

base of concrete in a steel shell which is bolted to the floor. The base and fan are separated from the drier box and framework. This reduces about 90 per cent of the noise made by the fan when attached to the framework and is worth the small extra cost (Fig. 5).

A guard of coarse wire mesh protects the blades from clothing, etc. The back end of the drier has an aperture about 2 ft. square to allow easy exit to the moisture-laden air. Cold dry air comes to the fan from a partly open window close by, and the warm, moist air from the open end disseminates throughout the hall and rooms in winter, aiding heating and ventilation. In summer, it is partly sucked out of the room by a turbine fan.

The cost of the drier is mainly that for the fan (between $50 and $75), depending upon the size and type; $100 to $200 for the heating elements, depending upon the wattage used; and the labor for building the simple box with three double pantry doors and a door into the dark room (probably less than $100). A vertically sliding door had to be used in our case because of lack of space. Sliding doors are apt to jam from the moisture and should only be used in case of necessity.

The capacity of this drier is very great. Seven frames of fifteen films (105 films) can all be dried and removed for sorting within twenty minutes after being placed in the drier in cold dry weather, and in summer in our climate they can be dried within thirty minutes. One rack of films close to the heaters will become absolutely dry in five minutes. A few films together in a frame close to the heaters have been dried in three minutes hard enough to place on viewing boxes without danger of sticking to the glass. At no time was the air temperature any where near hot enough to injure the emulsion. The drier has been run fourteen hours continuously, filled from one-third to two-thirds full of wet films and has not been over-heated at any time.

The air current, because of its distribution by the heaters acting as vanes, is strikingly little and very uniform in rate over the whole cross-section and length of the drier, in spite of the full frames. As it is just strong enough to blow a cloth like a pocket handkerchief out straight, it can be seen that damage in torn films is negligible. If the films are fixed tightly in their hangers before developing and do not tear out or become loose after washing, no trouble is had with them in the drier.

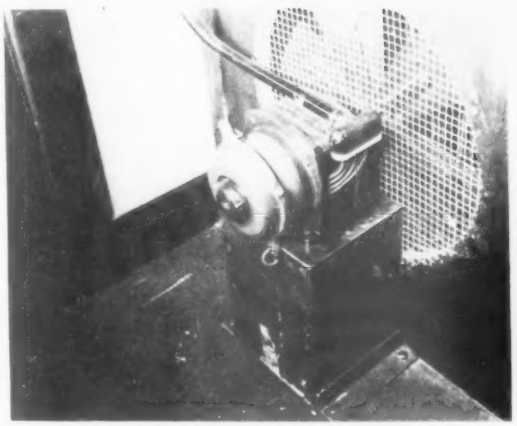

Fig. 5. Fan base and screen.

No repairs have been made in the two years it has been in service. The only vulnerable parts are the door sills, the zinc floor, and the roller castors which may rust and stick if not oiled frequently. Setting the drying racks upon a drainage pan on a shallow frame fitted with castors saves dripping upon the dark room floor when the films are loaded into the frames by sliding them into the proper slots.

The top of the drier acts as an unloading bench. The film hangers are removed from the frames, and the latter can be reached from the dark room through the vertically sliding door. The film hangers are sorted to be returned to the dark room, and the films are piled ready for clipping and sorting.

I am greatly indebted to Mr. Rymer, the hospital electrician, for the construction of the heater and fan mountings and the arrangement of the necessary circuits.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

ALLISON, R. G., and PHELPS, KENNETH. Non-opaque foreign bodies in the air passages. *Radiology*, Feb., 1928, x, 157–159.

Symptoms accompanying non-opaque foreign bodies in the air passages are: unilateral emphysema on the affected side, flattening and limited motility of the diaphragm on the affected side, and displacement of the heart and mediastinum toward the affected side. The history obtained from the mother is of much importance in such cases. Roentgenograms show the presence of opaque foreign bodies on first examination, but non-opaque foreign bodies require more skill and repeated roentgenographic studies. Every case which shows signs of unilateral emphysema with cardiac displacement should be subjected to bronchoscopy.

BABOK, D. Roentgen diagnosis of malignant tumors of bone. *J. de radiol. et d'électrol.*, Feb., 1928, xii, 62–71.

The author gives roentgenograms of 11 cases of malignant tumor of bone and tries to point out the characteristic features of the roentgen findings in each one. The first was an osteosarcoma with the geode figures so frequently seen in bone sarcoma. The tumor which was made up of cells transparent to the rays had invaded the whole center of the diaphysis, leaving a clear space dotted with calcium debris. In the lower part, there was an area of condensed bone that contrasted with the lacunar area. The next case was also one of sarcoma in which there was not yet complete destruction of bone, but considerable decalcification of the whole end of the bone. The normal trabecular structure was replaced by a field of irregular transparency. Case III was one of sarcoma of the lower end of the humerus. There was a lacunar zone with the same characteristics as in the above cases surrounded by condensed bone. The tumor had also invaded the soft parts. Case IV was one of sarcoma that had developed in a spindle shape around the diaphysis. The center of the bone looked normal, but that does not prove that it was so histologically. There were some needles of bone radiating from the cortex toward the periphery of the tumor. Case V was one in which a chloroma had involved both the center and cortex of the bone so it was hard to tell where it had originated. Two roentgenograms are shown, one taken at an early stage when the diagnosis of bone sarcoma could not be made. The case was treated for some time as one of tuberculous osteoarthritis. The roentgenogram taken later showed irregular zones of calcification and rarefaction; there was also new-formed tissue outside the diaphysis which, however, was osteoid and not true bone. The next case was one of peripheral almond-shaped sarcoma and central ossifying sarcoma. The periosteal tumor was implanted in a breach which it had made in the cortex of the bone; the whole center of the diaphysis was invaded and the most characteristic feature of the roentgenogram was irregular transparency. The next case was one of chondromyxosarcoma which showed the maximum signs of periosteal reaction together with diffuse infiltration of the whole diaphysis. The marrow was marked by a dark spot, and the bone was studded with spicules and spines of bone and prolongations in the form of flames. The outer boundary of the tumor was marked by a zone of ossification of the periosteum. The next case was one of sarcoma engrafted on an osteoperiostosis, probably due to hereditary syphilis, which the patient had had for about twelve years. The shadow of the tumor was superimposed on the darker shadow of the previous osteoperiostosis. The next case was one of osteosarcoma entirely external to the bone; it showed the characteristic appearance which has been described as that of a "brushwood fire." It had probably developed on a latent osteogenic exostosis.

The roentgen picture of metastatic cancer is easy to differentiate from that of sarcoma. The chief differentiating characteristics are multiple sharply circumscribed lacunar foci with absence of hyperostoses. The next two cases are ones of hypernephroma in which the bone looks as if distended and the apparently new-formed bone is really old bone involved in the growth of the tumor.

BAILEY, HAMILTON. Traction fracture of the small trochanter of the femur; with a report of an apparently recurrent case. *J. Bone & Joint Surg.*, April, 1928, x, 336–338.

Traction fracture of the small trochanter is rare. A report is given of a case occurring in a boy aged thirteen, who was seized with a sudden agonizing pain in the left thigh while

running. A roentgenoscopic examination showed nothing abnormal. The pain became so intense that he had to be transferred to the hospital in an ambulance. He pointed to the anterior surface of the left thigh as the site of the pain and also to the left loin. The thigh was palpated and the hip joint rotated without eliciting the slightest abnormality. The patient was asked to sit up, and when he had almost reached the upright sitting position he gave a piercing shriek, his face became livid and he turned upon his left side and literally writhed with pain. A few minutes later all the signs of the pain had gone. It was not until a roentgenogram of the hip joint was taken that the diagnosis was clear. The film showed avulsion of the small trochanter with the appearance of a fragment suggesting that it was a separated epiphysis. Forty-eight hours later the pain had abated and the patient was able to sit up. Ludloff's sign of fracture of the lesser trochanter to wit, inability to raise the thigh when in a sitting posture, was clearly demonstrable.

The patient had had an exactly similar attack of pain six years previously, and it is therefore assumed that union by fibrous tissue had occurred in the first instance and that this had ruptured at the time of the second avulsion. The hip joint was put into flexion and abduction for fourteen days, when massage was commenced. The patient regained perfect function of the limb. Roentgenogram two months after the accident showed the small trochanter joined to the shaft at a slightly higher level than normal and with a considerable amount of callus formation.

Ball, R. P. Pulmonary atelectasis following thyroidectomy. *Arch. Path.*, May, 1928, v, 763–774.

Four fatal cases of lobar atelectasis are reported, 2 unilateral and 2 bilateral. In each case death followed an operation on the thyroid gland. The pathologic observations were similar in all. The atelectatic lobes were characteristic in appearance, presenting a disproportion in the size of the lobes, the atelectatic lobes being sharply demarcated by color, by a clean, glistening pleura and by a flabby, limp consistency. The microscopic examination disclosed a picture not easily confused with any other lesion of the lung.

The etiology of these cases is apparently best explained on a mechanical basis, the most essentially responsible factor being a lowering of the intrapulmonary pressure. In 2 incomplete experiments on dogs the intra-alveolar pressure was lowered without resulting atelectasis.

Belden, Webster W. A case of colloid carcinoma of cecum. *Radiology*, Feb., 1928, x, 160–162.

In this case, the roentgenogram showed a typical hour-glass stomach which was interpreted as carcinoma, in view of the history and the patient's general appearance. At autopsy, the stomach and small intestine showed no lesion except that the small intestine was distended with liquid feces. The cecum was adherent and upon opening was found to be ulcerated and the cavity filled with a yellowish-purulent, foul-smelling material. Surrounding the tip of the orifice from the base of the appendix was a soft, jelly-like, mucinous tissue which appeared like colloid carcinoma. The microscopic examination confirmed the diagnosis to be colloid carcinoma of the cecum. The rest of the organs were negative. This case is of particular interest since the roentgenologic examination and the symptoms and history pointed to carcinoma of the stomach, whereas the real diagnosis proved to be colloid carcinoma of the cecum.

Bernstein, Maurice A. and Arens, Robert A. Epiphyseolysis. *Radiology*, Dec., 1927, ix, 497–505.

The roentgenogram was made use of in confirming the diagnosis of epiphyseolysis and was of much value in studying the actual changes which had taken place. The extent of the separation is clearly outlined in the roentgenograms submitted and details of position, size of head of femur and neck are easily studied in this way.

Bettman, Ralph B., and Arens, Robert A. Acute pleural empyema. *Radiology*, Feb., 1928, x, 153–156.

The roentgenogram offers one of the most valuable aids in establishing the diagnosis of acute pleural empyema, and also in following up the course of the disease and determining when treatment may be discontinued. The anteroposterior and posteroanterior projections are far better in the average case than the usual stereogram, and information may be obtained from either or both which would be entirely missed from a stereogram. Also, it is possible to obtain a clearer shadow because the encapsulation will probably be nearer the anterior or posterior position. Roentgenograms should be taken in the upright position, since information is usually brought out which is not noticed if the prone position is used. Encapsulation of pus often occurs and the roentgenogram often is the only means of demonstrating them and showing their exact location. The authors

emphasize the importance of coöperation between the surgeon and roentgenologist in the diagnosis and treatment of acute pleural empyema.

BLANCE, CLARKE, and LIVESAY, HARVEY R. A home-made preparation of iodized oil for opaque injections of tuberculous sinuses. *Am. Rev. Tuberc.*, May, xvii, 481–488.

Details are given for the preparation of iodized oil made from Mazola oil (corn oil). If properly prepared, this contains no free iodine. It remains light colored when stored in the ice box but should be retested each time with soluble starch for the presence of free iodine. Before use it must be warmed on the waterbath to body temperature. The preparation is not easily broken down. Stomach contents and bile do not liberate free iodine from it. Subcutaneous and intraperitoneal injections into guinea pigs do not seem to cause any discomfort. In the peritoneal cavity the preparation will slowly change color. A white fatty material appears on the outside of the mass, but smears from this do not show a true exudate. It apparently is always sterile.

The occasion for the preparation of the above iodized oil is the fact that barium and bismuth of density thick enough to cast a roentgen shadow will not penetrate into very small tuberculous sinuses, whereas this oil can do so. It does not stay in the sinuses but drains out readily It has the further advantage that in not blocking the sinuses it will not cause burrowing in new directions. Any amount may apparently be used without causing any reaction. It seems to be absolutely non-irritating and apparently has no effect upon the normal amount of drainage from a wound. The authors claim that this oil is so cheap that the cost is of no consequence and that it is far superior to any material now in use.

Seven typical cases are cited of a group presenting large tuberculous pockets connected by very small sinus tracts, patients who went for years without a diagnosis, or at least without a correct diagnosis, and consequently without treatment for the condition that existed. These cases also are typical in the fact that the cold abscesses were operated under the mistaken diagnosis of appendicitis, perinephritic abscess or hernia, and the few abscesses that escaped any of these diagnoses were either opened and drained intentionally or were allowed to open spontaneously. In order to use the iodized oil for outlining the sinus tracts in such cases, it is necessary to inject it under some pressure (2 or 3 lb.) and this pressure should be held for at least five minutes before the picture is taken so as to give the liquid time to fill all the larger pockets.

BLOCKER, J. D. A fenestrated shield for roentgenography of the nasal accessory sinuses. *Radiology*, Feb., 1928, x, 163–164.

Because of the distortion obtained when the nasal accessory sinuses are obtained in a single sagittal view, the fenestrated shield described here makes possible clear roentgenograms of both frontal and ethmoid sinuses on a single 8 × 10 film. The mask consists of a lead plate 1.15 mm. thick faced on each side with a sheet of brass 0.4 mm. thick; the mask is large enough to cover an 8 × 10 cassette exactly. Two discs are cut out which are spaced 12 cm. center to center. The roentgenograms are made one at a time, the disc covering the part of the film not being exposed at the time the other side is being used. The reverse order is then used to make a roentgenogram of the other sinus area. In this way clear roentgenograms can be obtained of both sinuses on the same film.

BRAILSFORD, JAMES F. The *x*-ray diagnosis of pathological conditions of the gall-bladder. *Brit. M. J.*, March 24, 1928, i, 484–486.

While there are many patients with symptoms so severe and urgent that a laparotomy is essential, there are others with symptoms so indefinite and atypical that no surgeon would care to do a laparotomy. In this latter type of case a roentgen investigation of the gall-bladder will often prove of much value. The roentgen examination in many cases proves that a laparotomy would have been useless; further, cholecystography enables one to obtain a fairly accurate opinion of the function of the gall-bladder, while a laparotomy may fail to do this.

The author has carried out nearly 500 cholecystographic examinations and the high percentage of accurate results as proved by operation fully justifies the procedure. A preliminary roentgen examination is an important part of the method, and it should be combined with a subsequent barium meal while the gall-bladder is still visible. The preliminary roentgenography will often throw much light on the diagnosis and might give indications rendering the dye injection unnecessary.

Among the lesions previously unsuspected which have been revealed by the preliminary investigation are: (*a*) *In the thorax;* (1) early tuberculosis with gastric symptoms; (2) pulmonary tumor; primary or multiple metastases from the abdominal organs; hydatid and cysts; (3) aneurysm. (*b*) *In the abdomen;* (1) stone in the kidney or ureter; (2) calcified tumor in the

kidney; (3) gallstones; (4) lesions of the spine causing abdominal pain; (5) abdominal aneurysm. A few illustrative cases are cited.

Brailsford, James F. value of radiography in the diagnosis of obscure dental sepsis. *Brit. M. J.*, June 16, 1928, i, 1013–1016.

The roentgenogram is of the greatest value in patients suffering from dental infections unassociated with local pain. The lesion is often unsuspected by the patient, and apparently is not and cannot be detected by the most carefully applied clinical tests. The author is of the opinion that every tooth producing systemic disturbance shows definite change on the roentgenogram.

Misinterpretation of the dental roentgenogram is due chiefly to lack of experience in interpreting the shadows and to lack of knowledge of general and dental pathology.

Brown, Marion E. Ocular manifestations of diseases of the paranasal sinuses. *Radiology*, Nov., 1927, ix, 418–432.

The value of roentgenologic examination in diseases of the paranasal sinuses is emphasized. Roentgenograms are submitted to illustrate the comparison with visual charts. The roentgenologic findings substantiate the diagnosis of the otolaryngologist in practically all cases. In some cases, the diagnosis is dependent solely on the roentgenogram.

Brown, Samuel. Differential diagnosis of abdominal tumors by the roentgenological method. *Radiology*, Jan., 1928, x, 48–56.

Because of the difficulty of determining the exact location of abdominal tumors with respect to specific organ by the usual dorsal and ventral roentgenograms, the author has made very successful use of lateral views for this purpose. Accepting as a rule that "an alteration in the position, shape and size of one organ will produce an alteration in the position or shape of its neighboring organ or organs," the author by obtaining roentgenograms of lateral views together with dorsal and ventral, is able to determine very accurately the organ involved in tumors and also enlarged organs. Illustrations of roentgenograms are submitted to show how this new information can be used. Brief case reports are given in which this method has been accurately used to show not only the location of the tumors, and the organs involved, but also the extent of displacement which they have caused. Enlargement of the pancreas can also be demonstrated by this means, which is impossible by the anteroposterior view. Knowing the exact location and probable origin of abdominal tumors will aid the surgeon to institute the proper surgical procedures.

Carter, L. J. Colonic dynamics. *Radiology*, Jan., 1928, x, 16–20.

In opening a symposium on colonic conditions, the author has briefly summarized colonic function as it may be interpreted from the roentgenologic examination. There is no standard by which abnormalities may be compared since the normal colon shows wide variations. It is necessary, first, to study extreme normal types and recognize the general conformity of the colonic appearance with the bodily habitus of the individual. The possibility of arrest of colonic development, which may occur at any stage of embryonic life, must also be considered. With these possibilities as to position and appearance in mind, the roentgenologist is aided greatly in arriving at accurate diagnosis of abnormal colonic conditions. The author then reviews in a general way the abnormal conditions which are apt to be met with in the routine practice of the roentgenologist.

This phase of gastrointestinal roentgenology is in a state of development comparable to that which the study of cardiac diseases passed through. Already many prominent pioneers in the field have led the way by their specific contributions to extensive progress which is now being made.

Cassar, A. Diverticulum of second portion of duodenum. *Radiology*, Dec., 1927, ix, 515.

After a barium meal the roentgenogram showed a pouch in the external part of the second portion of the duodenum. The diagnosis indicated three possibilities: (1) probable gall-bladder disease, (2) adhesions and (3) diverticulum. Upon operation, thirty stones were found in the gall-bladder, there were many adhesions and indications of diverticulum. In this case, the barium meal brought out the condition noted after two administrations of iodeikon failed to visualize the gall-bladder.

Chadwick, Henry D. The x-ray and clinical diagnosis of tuberculosis in children. *Am. Rev. Tuberc.*, April, 1928, xvii, 318–325.

A diagnosis of juvenile tuberculosis can be made only from a study of the roentgenogram. It is safe to classify as tuberculosis all tracheobronchial lymph nodes and pulmonary nodules showing evidence of calcification. One must not be deceived by the circular or oval densities due to blood vessels caught in the same axis

as the roentgen ray. Close beside these spots are often seen the accompanying bronchus in cross section. They are often found near the hilum in the fifth interspace posteriorly. Similar vascular spots are occasionally seen along the descending right bronchus.

The cases in which hilum shadows are considerably increased in area or density but do not show definite lymph nodes or lymph node masses should be considered as suspicious. These suspicious cases, if they are found to be reactors and have symptoms indicating activity should be given as careful supervision as those with a positive diagnosis. Such cases may have tuberculous lymph nodes undergoing caseation but no deposit of calcium has as yet taken place. They are not dense enough to be visible in the normal hilum shadows. Moreover, the diseased lymph nodes may be behind the sternum or obscured by the heart shadow. The primary lesion may be too small to see or be hidden by the ribs or dome of the diaphragm. Only in a small percentage of the children that have juvenile tuberculosis is a positive diagnosis possible. It is emphasized that a positive diagnosis of hilum tuberculosis should not be made unless evidence of calcification is seen in the tracheobronchial lymph nodes or primary nodules in the lung.

Other cases with doubtful shadows at the hilum or extending out from it should be classified as suspicious. The ratio of suspicious cases to positive ones is about three to one. The positive cases as indicated by the deposit of calcium have shown a tendency to heal. The suspicious cases for lack of elapsed time or some other reason, have not as yet demonstrated their ability to protect themselves from the tubercle bacillus. This group of suspicious cases therefore should be kept under observation and receive intelligent treatment until sound health is assured.

CHAPMAN, JOHN F. The value of the lateral exposure in the roentgen examination of the chest. *Radiology*, Feb., 1928, x, 139–149.

Roentgen-ray examinations of the chest should include roentgenoscopic examination and a single film in the anterior position and one in the direct lateral position. The right lateral position is taken, but if roentgenoscopic examination shows the lesion to be on the left side, a left lateral film is also taken. These lateral views are of much importance in diagnosis, especially in the following conditions: abscess, interlobar collections of fluid, localized pleural effusions, bronchiectasis, pneumonia, pleural adhesions and foreign bodies. In cases of lymphosarcoma, Hodgkin's disease and tuberculosis, the lateral views are less important than at first considered. Case reports and roentgenograms to illustrate the conditions found are given. Lung abscesses, interlobular collection of fluid, chronic pneumonia, collection of pleural fluid, pleural adhesions, hilus pneumonia, etc., are described and illustrated from the lateral and anterior positions.

CHAUMET, G. Roentgenography of the sinuses. *J. de radiol. et d'électrol.*, Jan., 1928, xii, 1–15.

Demonstration of latent sinusitis is very difficult. Complete opacity of a cavity is evident on almost any plate, but extreme care is necessary in order to show thickening of a mucous membrane or moderate effusion. There are certain superpositions of shadows that must be known in order not to misinterpret accessory shadows, particularly in the positions that are now most in favor, the vertex-plate and chin-plate incidences recommended by Hirtz and the use of the intrabuccal film for photography of the sphenoid. The author thinks it is not possible to judge the condition of the sinuses from any single incidence. The positions of Hirtz are valuable but they involve sources of error, and the intrabuccal film presents the same sources of error except for those which result from the floor of the mouth and the clear spaces of the larynx and trachea which are negligible. Therefore, different control positions must be used and among these that with the face against the plate, which the author calls simply the face incidence, is of great value. Illustrative roentgenograms are given supporting the author's argument that this is true. To study the sphenoid sinus, the vertex-plate and chin-plate incidences, with the chin in maximum extension should be used, the profile view and, as an auxiliary method, the face incidence. For the ethmoid the vertex-plate and the face incidences should be used; for the frontal the face, profile and chin-plate with the chin in semiflexion; for the maxillary sinuses the face and chin-plate incidences with the chin in maximum extension.

DWYER, MAURICE F. Report of a case of thymoma. *Radiology*, Dec., 1927, ix, 510–512.

After a diagnosis of thymoma in a man aged forty-two, roentgen-ray therapy was indicated. A treatment consisting of 600 ma. min. at 145,000 volts, 16 in. distance with .025 mm. copper on 1 mm. aluminum filtration was administered in the course of four successive days. Half this dose was given through the front of the chest and half through the back. When the patient returned a month later, the

symptoms had completely disappeared and the tumor had been reduced to one-sixth its former size. A second series of treatments was given, using the same factors, which resulted in a slight reduction from the last state. After a third treatment, the patient recovered entirely and no evidence of the tumor could be seen in roentgenograms even three years later. Roentgenograms are submitted to illustrate the progress of cure after treatments.

Eiselsberg, A., and Sgalitzer, M. The surgical importance of x-ray examination of the oesophagus and the pharynx. *Surg., Gynec. & Obst.*, June, 1928, xlvi, 837–844.

In incomplete stenoses of the esophagus, roentgen-ray examination with the patient in the horizontal position furnishes important information of the length and form of the stenosis. Since, in horizontal position the passage of the paste through the esophagus is retarded, the latter is well filled within and below the point of stricture, as well as above the stenosis, and this enables orientation as to the length and shape of the stricture. This advantage is not afforded by examination of the patient in the upright position. This knowledge is especially important in the case of cicatricial strictures of the esophagus because it affords assistance in endoscopic treatment. The diagnosis of diverticula, particularly of traction diverticula, is also enhanced by this method.

This method of roentgen examination is also valuable for the diagnosis of tumors of the nasopharynx and hypopharynx, as the diagnosis of these growths is quite uncertain when examination is made in the upright position. In the horizontal position, the paste has an opportunity to fill completely the pharyngeal cavity. The defect in this picture indicates the size of the tumor, and one can see the entire extent of the neoplasm insofar as it protrudes into the pharyngeal lumen. Since, in general, laryngological examination cannot reveal the linear extension of the neoplasm, the knowledge gained by this method of roentgen examination undoubtedly increases the opportunity for determining with greater certainty whether further treatment is indicated, and at the same time it extends the horizon of diagnostic ability.

Eikenbary, C. F. Primary tumor of sacrum. *J. Bone & Joint Surg.*, April, 1928, x, 200–201.

Primary tumors involving the sacrum are rather rare. A report is given of a case occurring in a boy, aged seventeen, complaining of pain and disability of the lower portion of the back which had existed possibly for two years previously. The roentgenogram of the sacrum showed that there was a dense mottled shadow covering the lower half of the sacrum and extending slightly beyond the middle line. The tumor mass involved the entire thickness of the sacrum. There was quite a considerable amount of this same dense tissue anterior and below the prominence of the sacrum. The roentgenological diagnosis was a benign tumor, possibly an osteochondroma. Biopsy showed an osteofibrochondroma. No operative treatment was recommended.

Eliot, Martha M., Souther, Susan P., and Park, E. A. Transverse lines in x-ray plates of the long bones of children. *Johns Hopkins Hosp. Bull.*, 1927, xli, 364–388.

A description is given of the anatomical conditions in the bone which are responsible for the appearance of transverse linear shadows in the image on the roentgen plate. Observations were made concerning the occurrence of transverse lines in the roentgenograms of bones of children, chiefly in the radius and ulna. If one scans roentgenograms of bones of infants and children for transverse lines, one finds them or traces of them so often as to be forced to think that the phenomenon is quite common. In many children several lines can be observed at the rapidly growing ends of each long bone, in some instances as many as twelve. They are of much more frequent occurrence in children who have been acutely or chronically sick than in those who have always been well, and are most numerous in those who have had wasting diseases or have been malnourished for long periods of time. The lines are more frequently found in bones which are rarefied, possibly because more easily visible there. The transverse lines are almost always symmetrically disposed in the skeleton. A given line may not be quite so clearly outlined on one side as on the other, and if faint in one bone may not appear at all in its fellow, or be represented only by traces.

The lines are most commonly found and are most conspicuous in those parts of the long bones where growth is taking place with the greatest rapidity. These transverse lines in the long bones are always exactly parallel to the ends of the shafts. The parallelism between the lines and the margins at which the growth is taking place is an observation of greatest importance since it points to the seat of origin of the lines in the growth surfaces. These transverse lines in the shafts in some cases show a double outline corresponding to that

of the end of the shaft. At the slowly growing ends of the long bones the transverse lines, if present, always lie close to the cartilage; at the rapidly growing ends they may occupy any part of the distal third of the bone, but as a rule are better defined near the cartilage. The lines may display great difference in density, some are exceedingly bright, some are just visible. Their thickness varies from that of a hair to the mark of a soft pencil.

As one follows the disappearance of the transverse lines in a consecutive series of roentgenograms, one may see that although the line may become fainter as a whole, it does not fade equally at all points. Gaps form which become wider and more numerous, converting the line to a few fragments or points, and finally perhaps reducing it to a single point in the finer structure of the shaft. The authors have been able, through the examination of the plates in a series to identify transverse lines in the process of formation at the cartilage-shaft border. Transverse lines never move in relation to each other in the course of growth, and therefore afford a beautiful natural proof that interstitial growth of bone does not exist. Transverse lines are frequently found to alternate with parallel zones of apparent rarefaction.

Microscopical studies were made of the anatomical conditions of the bones responsible for the transverse lines in the roentgen plate. The formation has its origin in the cartilage-shaft junction. The growth of the cartilage is suddenly slowed or stopped; as a result the bone building energy of the shaft concentrates at a single level or at very slowly changing levels and discharges itself in a more lateral direction than usual. The result is the formation of trabeculae which extend transversely or are actually joined to neighboring trabeculæ by cross branches. When the growth of the cartilage becomes reawakened, trabeculæ with the ordinary parallel longitudinal arrangement are again formed and the lattice is left behind in the shaft.

On the other hand, in rickets when lime salts are again deposited in the bones, a transverse line develops representing the deposition of lime salts. This transverse line represents a zone of provisional calcification and is visible for only a short period of time because the contrast is soon effaced as the underlying rachitic zone rapidly becomes impregnated with lime salts. True lattice formation of the kind causing the typical transverse lines does occur in bones showing advanced rickets, but does not stand out clearly in the roentgenogram, perhaps because of the scanty amount of lime salts which the trabeculæ responsible for them contain.

The roentgenograms of bones of children and animals which have been in uninterrupted health show the cancellous tissue of the shaft to be homogeneous and permit the inference that growth at the cartilage-shaft junction has been of an even kind and gone forward at a constant rate. Roentgenographic studies of the bones showing variations above described in the architecture indicate that the growth force must have been over a long period of time in a state of fluctuation, progressing and halting as the result of disturbed relation between supply and demand of building materials.

Elsberg, Charles A., and Silbert, Samuel. The ventricular system. *Arch. Neurol. & Psychiat.*, April, 1928, xix, 596–616.

In a large number of instances of cerebellar disease, the symptoms and signs of a lesion in the posterior cranial fossa are so well-marked that studies of the ventricles are unnecessary. When the diagnosis of the location and of the nature of the disease are uncertain, the information to be obtained from studies of the ventricles may be of considerable value. The evidence obtained by ventricular puncture and estimation by the injection of dyes and by ventriculography is not always unequivocal, and one is sometimes dealing with probabilities rather than certainties. Tumors in one or the other location may cause pressure on more than one part of the pathways of the cerebrospinal fluid, and other parts of the ventricular system may be compressed by the dilated ventricles themselves.

If progressive signs and symptoms point to a cerebellar lesion the presence of dilated ventricles determined by puncture of one or both posterior horns makes the presence of an expanding lesion probable. If, in addition, examination of the urine after injection of phenolphthalein into a lateral ventricle fails to show a large amount of dye in the urine within two hours, the diagnosis of an expanding lesion in the posterior cranial fossa is so well grounded that injections of air and ventriculography are unnecessary. If, however, ventriculography has been performed, the occurrence of dilated ventricles with regular outlines gives support to the diagnosis of a lesion of the posterior fossa. The contralateral ventricle is usually the larger one and the posterior horn of the lateral ventricle on the same side as the tumor is often dislocated forward, outward and upward.

When the diagnosis rests between a tumor of one frontal lobe or of the opposite cerebellar lobe, and puncture of the ventricle on the side of the possible frontal lesion discloses a dilated

ventricle, the growth is, in all probability, in the posterior fossa. If, in addition, the other lateral ventricle is punctured and is found to be also dilated, and indigo carmine or other dye passes from one to the other lateral ventricle, the probability is made a certainty and injections of air are not necessary.

If the clinical diagnosis favors the presence of a supratentorial growth which is pressing the third ventricle, but if a cerebellar neoplasm cannot be excluded and puncture of the lateral ventricle on the side on which the tumor is presumed to be shows that the ventricle is dilated, a subtentorial lesion cannot be excluded until air has been injected and the ventriculograms studied. Tumors which cause a bilateral dilatation of the ventricles from compression of any part of the third ventricle usually cause some defect in the regular outline of the ventricles, as seen on anteroposterior roentgenograms. If the ventriculograms show that the third ventricle is dilated, the obstruction must be either in the hindmost part of the third ventricle or behind it, and the probability of a lesion of the posterior fossa becomes greater.

That there is a certain amount of danger from the injection of air by ventricular puncture is without question, and it would be a great advantage if, in lesions of the posterior fossa, the air could with safety be injected by the lumbar route. Ventricular estimation should always be performed first, in order to determine whether both lateral ventricles are dilated and the foramina of Monro are patent. In the majority of cerebellar tumors, ventricular puncture alone or ventricular estimation with studies by means of the injections of dyes will suffice, and injections of air and ventriculography will be performed only when the clinical and ventricular evidence of a cerebellar new-growth is inconclusive.

FAULKNER, DONALD M. Bipartite carpal scaphoid. *J. Bone & Joint Surg.*, April, 1928, x, 284–289.

A report is given of a case occurring in a baker, aged twenty-four, whose chief complaint was pain and disability of the left wrist, with the same trouble, though of less degree, of the right wrist. At no time were any other joints involved, except that he did have some discomfort and soreness about his ankles and foot on standing and walking. The past history contained nothing of interest except gonorrheal infection six years previously.

The roentgen examination showed a very marked, fairly symmetrical bilateral deformity of the scaphoid bones in the hands. Each scaphoid consisted of two pieces. All fragments were very irregular, having rather sharp edges. The wrist spaces were narrowed. The styloid processes of the ulnae and of the radii were sharpened. In making a diagnosis, two conditions had to be considered, the first being that each scaphoid ossified by two centers, forming a bipartite scaphoid, and that there was a superimposed infectious arthritis causing a narrowing of the wrist joint space on each side with spur formation. The second condition to be considered was that there may have been a severe osteo-arthritis attacking principally the scaphoid bone, causing a pathological fracture of it together with a narrowing of the wrist joint space and spur formation of the styloid processes. The condition was practically the same on both sides.

Dr. R. B. Osgood, who reviewed the roentgenograms and the history, suggested a congenital variation of the carpal bones, probably in the nature of a bipartite scaphoid with an imperfect joint between the fragments and a definite arthritis and proliferative changes as a result. He thought that the arthritis might be due to the old gonorrheal infection. Gonococci were found in a prostatic smear and after two or three treatments for chronic gonorrhea the patient became discouraged and was not seen again for several months. When next seen, he was symptomatically worse. Since the treatment of the gonorrhea did not improve his condition, excision of the carpal scaphoids was considered proper. At operation the styloid process of the radius was found sharper than usual, and there was an increased angle of inclination of the articular surfaces of the radius. The scaphoid was composed of two portions, a small ulnar part and a larger radial portion. There was no bony or ligamentous union between the two portions of the scaphoid; between them there were imperfect articular surfaces covered with cartilage in which were small areas of absorption or destruction, as seen in arthritis. There was also evidence of arthritis in the wrist joint proper. Postoperative convalescence was uneventful. After healing, physiotherapy was instituted with moderate improvement in function. The patient again became discouraged and has failed to return. The two portions of the scaphoid when fitted together bore little, if any, resemblance to a normal carpal scaphoid. However, articular surfaces for all the bones with which the scaphoid articulates were present, the concavity for the os magnum being partly on the ulnar and partly on the radial portion. It is therefore clear that bipartite carpal scaphoid with cartilaginous surfaces between the two fragments does occur. This abnormal joint may be

the seat of arthritis. The importance of a knowledge of this anomalous development of the scaphoid to the roentgenologist and to the surgeon is obvious.

FELLOWS, H. H., and ORDWAY, W. H. The value of routine fluoroscopic examinations of the chest among industrial employees. *Am. Rev. Tuberc.*, March, 1928, xvii, 201–203.

A number of employees of the Metropolitan Life Insurance Company were diagnosed as having advanced tuberculosis within a year after acceptance for employment, despite a thorough physical examination. It is therefore suspected that cases of unrecognized tuberculosis were being accepted in spite of rigid physical examination and careful questioning. Casting about for a more accurate means of detecting latent disease, skilled roentgenoscopists, well trained in this type of work were secured to examine each applicant. This means was employed with the last 800 applicants for positions. From these 800 applicants accepted after history and physical examination, 8 cases of well-developed pulmonary tuberculosis were found by roentgenoscopic examinations. Two of these showed calcified lesions, while 6 were classified as being potentially prospects for sanatorium care. These applicants shown roentgenographically to have definite tuberculosis were re-examined by trained physicians qualified to diagnose tuberculous lesions, and with 2 exceptions failed to show abnormal chest signs. This preliminary report indicates that roentgenoscopic examination of chests made by well-trained physicians experienced in this type of work detects tuberculous lesions which otherwise are unrecognized by physical examination alone.

GRANT, FRANCIS C. Indications for and technic of ventriculography. *Radiology*, Nov., 1927, ix, 388–395.

The exact location of intracranial lesions is necessary if effective surgical treatment is possible. In many cases the observed symptoms make the diagnosis of neoplasm certain, yet impossible to locate by any known tests. Ventriculography offers a means of determining the position of otherwise unlocalizable tumors. This method, however, should be used only after others have failed. There must be complete removal of the cerebrospinal fluid by bilateral ventricular tap and the injection of air into each ventricle separately. It has been customary to place the trephine openings in the parieto-occipital region 7 cm. above the occipital protuberance and 1.5 cm. lateral to the midline. Air is then forced in to replace the cerebrospinal fluid withdrawn. Roentgenograms are then made and the air pockets observed. In spite of the dangers and in spite of possible errors, this method affords more positive information about the situation of the lesion than any other method. The method should certainly be used before the patient is given up as hopeless.

Excellent roentgenograms are submitted to illustrate the possibilities of this method.

HEIN, BARNEY J. Osteogenesis imperfecta with multiple fractures at birth: An investigation with special reference to heredity and blue sclera. *J. Bone & Joint Surg.*, April, 1928, x, 243–247.

A report is given of a case observed in a girl, aged twenty-four hours, admitted with deformities and abnormal points of mobility over the long bones of all four extremities. The child had blue sclera, but all other organs appeared normal. On roentgen examination the child showed nine distinct fractures, namely, the right tibia and fibula, the right and left femora, the right radius and ulna, the right and left humeri and the right clavicle. The bones of the skeleton, especially the long bones, showed marked atrophy and were evidently very soft. This was shown by the character of the roentgenogram and also by the distortion of some of the thoracic vertebrae, especially evident in the fifth which was wedge-shaped. These changes probably were caused by pressure. There was no evidence of characteristic changes of syphilis or rickets about the joints or epiphyses. An examination into the history of the child and mother indicated that the multiple fractures were the result of an abnormal fragility of the osseous structures and not due to any unusual birth trauma. The diagnosis was osteogenesis imperfecta. The fractures were treated in extension. After about two weeks the fractures observed on previous examination were united, with evidence of callus in all instances and with exuberant callus in the right tibia and fibula. The remarkably rapid bony repair is interesting. The child developed an anemia four months later from which she died. At autopsy the head was found markedly flattened posteriorly with all bones fragmented. The cranium was of egg shell consistency. In holding the calvarium before the light, various lines of previous fractures could be seen. These fractures probably occurred at different times in the ordinary acts of turning and placing the patient in bed.

There was an unusual opportunity to study the family, and a complete investigation was made to determine what influence heredity

might play in this rather unusual condition. Twenty-three relatives, going back three generations, were investigated. In no instance was there present a history of fragile bones or blue sclera. The examination did reveal that there was an intermarriage, in that the mother and father were first cousins. However, no relationship was established between heredity on the one hand, and fragilitas ossium and blue sclera, on the other.

HENRY, C. M. Colonic stasis. *Radiology*, Jan., 1928, x, 41–47.

The normal filling and emptying time of the colon is somewhat variable, but it should begin to fill from the fourth to the sixth hour following barium meal, the entire meal having passed the ileocecal valve in eight to ten hours. The entire colon should be filled in twenty-four hours and be clear of the meal in from thirty-six to forty-eight hours. If there are delays longer than these in any portion of the colon, the reason should be determined, if possible. The usual causes of stasis in the colon are: incompetent ileocecal valve, adhesions and bands resulting from inflammatory conditions adjoining the cecum producing fixation, nonrotation of colon, distal pathology producing reflex stasis such as redundant pelvic colon, malignant disease of the rectum, distal colonic diverticulum and distal tumors producing pressure defect. Deficient muscular and sympathetic nerve tone are also factors which produce stasis. Roentgenograms are submitted to illustrate some of these causes of stasis.

HIRSCH, I. SETH. The roentgen diagnosis of malignant neoplasms of the lung. *Radiology*, Dec., 1927, ix, 470–496.

The author has presented an excellent argument in favor of close cooperation between the roentgenologist and the clinician in diagnosing lung tumors. He emphasizes the well-known fact that the roentgenologic diagnosis is far more accurate than the clinical and says further that in 98 cases out of 100 the roentgen examination gives a clearer and more accurate idea of the lung pathology than the most painstaking physical examination, and a series of roentgenograms taken at intervals gives a better idea of the activity of the lesion and its various pathologic phases than do any number of physical examinations. The remainder of the paper proves this statement and the author has submitted a large number of roentgenograms to illustrate a variety of conditions in which a clear diagnosis is made. Many conditions which are usually described by the clinician in rather vague and indefinite terms are easily diagnosed by means of the roentgenogram. The roentgenologist is able to make much finer distinctions regarding the extent of injury and also to establish definitely the location of the tumors.

HUME, J. R. The surgical diagnosis of paranasal sinus disease. *Radiology*, Nov., 1927, ix, 415–417.

Pathological changes may occur in the paranasal sinuses without being markedly visible. However, the roentgenologist is able to aid in such cases. In those cases in which the roentgenologist reported sphenoiditis and confirmed by contraction of visual fields for form and color, ethmo-sphenoidectomy is indicated. In cases reported positive by the roentgenologist and which are negative as regards visual fields, it is advisable to promote ventilation and drainage by submucous resection. The roentgenologist has been responsible for diagnosis in such obscure cases and after proper treatment the patients have recovered.

HURST, ARTHUR F., TURNER, TERENCE W., and VENABLES, JOHN F. The early diagnosis of cancer of the colon and rectum. *Lancet*, June 23, 1928, i, 1275–1277.

An opaque enema is of great value in demonstrating the site of any obstruction in the colon. It is a curious fact that the enema may be temporarily or permanently held up by an obstruction which leads to no obvious delay in the passage of an opaque meal. The actual passage of the fluid should always be watched, as a slight obstruction may lead to only a temporary delay in the passage of the fluid, caused possibly by spasm. The point where any delay is observed should be palpated under the screen, as it is not uncommon for a small tumor to become palpable when one's fingers are directed to its exact localization. Before accepting the apparent "hold-up" of an enema as evidence of a stricture, the patient should turn on his face as the fluid occasionally passes on in a normal manner when this is done. A good roentgenogram may show the nature of the obstruction, as the narrowing caused by adhesions, diverticulitis and a fibrous stricture following ulcerative colitis all give appearances which are to some extent characteristic and differ from the irregular jagged outline of that produced by a growth. A filling defect is sometimes recognizable in the complete absence of any obstruction. It is very important to remember that early cases of carcinoma of the colon may show no filling defect and cause no obstruction to the passage of an opaque meal or opaque enema.

In a series of 25 consecutive cases discussed by the authors, definite diagnosis was made in 5 cases by rectal and sigmoidoscopic examinations. An opaque enema was given to the remaining 20 cases. Obstruction was observed in 14 and a filling defect without obstruction in the remainder; in 4 of the 14 an opaque meal also showed obstruction.

JARCHO, JULIUS. Uterosalpingography. *Surg., Gynec. & Obst.*, June, 1928, xlvi, 752–768.

The consensus of opinion of most of the investigators who have employed iodized oils for visualization of the female genital organs is that the procedure is entirely safe and harmless and a most valuable addition to our equipment for making gynecological diagnoses. In the author's experience, it not only supplements but frequently supplants insufflation of gases. Uterosalpingography gives a vivid picture of conditions existing in the female genital tract. The most valuable use of the method is for the detection of occlusion of the fallopian tubes and the localization of the site of the obstruction. In many gynecological disturbances the method gives exact information that can be obtained by no other means.

Uterosalpingography reveals a definite sphincteric action at the uterine cornu, sometimes called the tubal sphincter. The author's experience suggests that the transuterine injection of iodized oil may have definite therapeutic advantages in subacute and chronic conditions of the fallopian tubes. A case is described in which uterosalpingography revealed dilatation and occlusion of both fallopian tubes but in which a second uterosalpingography ten months later gave an entirely normal picture. There is reason to believe that, in this case, the slow liberation of iodine within the fallopian tubes had a pronounced therapeutic effect.

JENKINSON, EDWARD L. The *x*-ray diagnosis of bone tumors. *Radiology*, December, 1927, ix, 453–462.

The greatest usefulness of the roentgenogram in the diagnosis of bone tumors is to differentiate between malignant and benign growths. This is readily done by means of the roentgenogram and constitutes a very definite means of making this distinction. If bone invasion is shown, the tumor is malignant, while if after thorough examination of roentgenograms taken from different angles, no evidence of invasion is shown, the tumor is benign. The author submits roentgenograms to illustrate the form, position and extent of involvement that can be brought out.

KANTOR, JOHN L., and JAFFIN, ABRAHAM E. Roentgen visualization of the bile ducts, with special reference to internal biliary fistulae. *Radiology*, Jan., 1928, x, 10–15.

The authors report 2 new cases of internal biliary fistulae. Before giving their case reports, they review the previous cases reported in the literature and remark on the rarity of this condition. It is observed after barium meal, and this means is relied upon for diagnosis. The first case reported is that of a man, aged twenty-nine, who had been suffering from duodenal ulcer. Operation revealed dense adhesions at the hepatic flexure, duodenum and cecocolon, with dilatation of the duodenum. No relief of symptoms followed operation, and later the patient experienced marked distress after meals, with vomiting of coffee-ground material. Roentgenogram after barium meal, showed filling of the extrahepatic bile ducts. It is evident that the ulcer of the duodenum had ruptured into the bile duct, giving a probable diagnosis of duodenal ulcer with spontaneous duodenocholedochostomy. The other case reported was that of a woman, aged sixty-three, who suffered from pain in the epigastrium and back. There was vomiting and jaundice with loss of weight. The pains became worse after meals. Roentgenogram after barium meal showed a free filling of the bile ducts well into the liver substance, without, however, vizualizing the gall-bladder. Some of the ducts retained the barium for at least 120 hours. Internal biliary fistula has until recently been positively diagnosed only at autopsy; now by means of the roentgenogram and barium meal it can be identified in the living subject.

KAY, FRANK A., and PACK, GEORGE T. Cholesteatoma of the brain. *Arch. Neurol. & Psychiat.*, March, 1928, xix, 446–453.

A report is given of an unusually large, nonhair-containing, epidermoid cholesteatoma, originating from the pia mater at the cerebello-pontile junction. This occurred in a man aged twenty-seven, who shortly after entering the hospital contracted influenza. This was complicated by bronchopneumonia which proved fatal. Autopsy showed that death was caused by bilateral confluent bronchopneumonia. Within the posterior cranial fossa was a large nodular pearly tumor situated at the cerebello-pontile junction, and involving the right cerebral peduncle more than the left. The total weight of the brain and tumor was 1215 gm. The weight of the tumor alone was 69.5 gm. and its dimensions 4 x 5.5 x 8 cm. Most true cholesteatomas are small and asymptomatic and are accidentally found at

necropsy. In this case the patient showed neurologic symptoms with positive signs pointing to a cerebellar lesion.

King, J. H., and Martin, Lay. A clinical evaluation of cholecystography by the oral administration of tetraiodophenolphthalein. *Johns Hopkins Hosp. Bull.*, 1927, xli, 219–225.

The Graham dye test attempts to determine whether or not the gall-bladder is exercising its normal function. The authors present the results obtained by means of the oral method in a series of 407 cases representing a variety of clinical conditions. These studies have shown that while the method is an aid in diagnosing diseases of the gall-bladder, it has certain limitations. It does not give positive assurance that a normally functioning gall-bladder is organically normal. It may give misleading information. If the gall-bladder fills and empties normally with the dye, the resulting picture need not necessarily depend upon the method of administering the dye. However, in a series of patients who were operated on and who showed by the dye test a normally functioning gall-bladder, 9 out of 20 were found to have a diseased gall-bladder. Hence, it is fair to conclude that there is a probability of error in diagnosing a gall-bladder as normal whether the dye be given intravenously or by mouth.

In the non-filling gall-bladders this finding will not always assure the clinician that a gall-bladder is diseased, although this possibility of error is less (20 per cent). A so-called delayed filling of the gall-bladder cannot be taken as evidence of early gall-bladder disease, or for that matter, of any disease. In many of the control cases in the series studied there was greater concentration of the second (19-hour) film, than in the first.

The number of stones demonstrated roentgenographically after dye administration was found decidedly greater than without it. It is concluded that the evidence offered by the Graham dye test must be carefully compared with the information gained from clinical studies of the cases under consideration. The method is helpful but not absolute.

Kirklin, Byrl R., Caylor, Harold D. and Bollman, Jesse L. The concentration of cholecystographic mediums and bilirubin by the gallbladder. *Radiology*, Dec., 1927, ix, 463–469.

As a result of this study, the authors conclude that, while cholecystography is a reliable test of the function of the gall-bladder, dependence on it should not be encouraged to the exclusion of older clinical methods. Cholecystography is not only valuable in the diagnosis of cholecystic disease, but offers a means of studying the physiology and pathology of the gall-bladder.

Levine, Samuel. Congenital malformations of the gallbladder. *Arch. Int. Med.*, Feb. 15, 1928, xli, 198–209.

Congenital anomalies of the gall-bladder are frequent in animals, particularly in sheep, cattle and cats. They are said to be rare in man. All of the cases reported in the literature, except one, have been anomalies observed only when the abdomen had been opened by the surgeon or the pathologist. By means of cholecystography, however, physicians are able to study this condition in the living patient in whom this observation may be made accidentally. Three interesting anomalous gall-bladders were observed in the author's private practice during a period of a few months.

The first case cited occurred in a woman aged twenty-three. Roentgenographic and roentgenoscopic examinations of the gastrointestinal tract did not reveal any abnormalities with the exception of constant tenderness in the lower right quadrant of the abdomen. The appendix was not visualized. Fourteen hours after oral administration of tetraiodophenolphthalein roentgenograms showed the gall-bladder distinctly. At the junction of its middle and lower thirds, a circular constriction divided it into a wider upper and a narrower lower portion. Ten minutes after the ingestion of a fat meal, the gall-bladder was about one-half its former size. Proportionately, the lower cavity had diminished in size more than the upper. Two and a half hours after the administration of the dye, only a small speck of it was seen in the gall-bladder. This case of hour-glass gall-bladder was probably of congenital origin.

The second case presenting a gall-bladder resembling a "Phrygian cap" occurred in a woman aged twenty-six, suffering from hyperthyroidism, menstrual irregularity and sterility. Roentgenoscopic and roentgenographic examinations of the gastrointestinal tract showed that the stomach extended down one and a half handbreadths below the crest of the ilium; the incisura angularis was two finger-breadths below. Tenderness was present to the right of the umbilicus. After four hours, the stomach was empty and after twenty-four hours the entire gastrointestinal tract was empty, but the appendix was filled. The latter was irregular in outline and beaded. Fourteen hours after the oral administration of dye,

roentgenograms showed the gall-bladder clearly. Its lower pole was bent upward and toward the spine. Two hours after the ingestion of a fat meal, the gall-bladder was empty. This type of gall-bladder is regarded as a sign of constitutional inferiority, often associated with lymphatism, status thymico-lymphaticus, hernia, genital hypoplasia and a narrow aorta, and it predisposes to tuberculosis, syphilis, cystic ovaries and adenomatous goiter.

The third case was one of rudimentary gall-bladder, presented by a man aged twenty-two. The gastrointestinal examination revealed a moderately ptosed stomach, and the appendix remained filled forty-eight hours after the barium meal, while the rest of the large intestine was empty. Twelve hours after the oral administration of dye, roentgenograms showed the gall-bladder distinctly. It was about one-third the normal size and conical, and its fundus tapered to a point. Two hours after the ingestion of a fat meal, it was still about one-half full. Constitutionally the patient was of the thymic type. The gall-bladder in this patient was of rudimentary morphology, being less differentiated from the cystic duct, more mobile, and its emptying power impaired.

LEWIN, PHILIP. Avulsion of the lesser femoral trochanter. *J. Bone & Joint Surg.*, April, 1928, x, 339–343.

About 44 cases of avulsion of the lesser femoral trochanter are reported in the literature. The similarity of the histories and the ages of the patients is noteworthy. Practically all cases occur between the twelfth and the sixteenth years, predominantly amongst boys. The etiology is always injury, either direct or by muscular pull. The symptoms of avulsion are those of disturbed function of the iliopsoas, viz., limp due to inability to flex the leg, and pain and tenderness in the region of the lesser trochanter. Two signs to which the author calls attention are brought out as follows: The patient sits on a table with both legs hanging over the side. He is instructed to raise his well leg and place his heel on the table. He then attempts the same movement on the affected side but fails. The second sign is brought out by having the patient stand squarely on both feet with knees extended. He is directed to bend from the hips and pick up an object from the floor, which he is unable to do. Ludloff's sign is considered pathognomonic: in the sitting position, the patient is unable to flex the extended limb.

Roentgenograms reveal the separation and upward displacement of the epiphysis of the lesser trochanter. In order to demonstrate this condition to advantage, the thigh should be extended, abducted and rotated outward. The rays should be directed straight from above and both sides should be shown on the same film. After the films have been made, the affected limb should never be allowed to assume the extended position until cured. The conditions about the hip which must be differentiated are fracture, dislocation, epiphysitis, septic arthritis and epiphyseal coxa vara. The prognosis is uniformly good. The course is from six to ten weeks. The treatment is based upon simple principles of anatomy, mechanics and orthopedic surgery. An illustrative case in a boy aged fourteen is cited.

LINCOLN, EDITH M., and SPILLMAN, RAMSAY. Studies on the hearts of normal children. II. Roentgen-ray studies. *Am. J. Dis. Child.*, May, 1928, xxxv, 791–810.

A report is given of a study made over a period of seven school years based on yearly roentgenograms of 246 normal school children. All the roentgenograms were made with the child in a standing dorsoventral position at a distance of 6 ft. The exposures varied from three-eighths to three-fourths of a second, with the central ray passing approximately through the fourth dorsal vertebra; they were made in moderately deep inspiration, except in a few cases in which the child was too young to coöperate. Measurements of the right and left diameters of the heart and of the longitudinal diameter were taken in the standard manner. The measurements of the longitudinal diameter seemed arbitrary and bore little relation to the actual size of the heart.

The average median diameter of the right side of the heart increases steadily with age in children from two through thirteen years of age, being greater in girls than in boys at the extremes of the age groups. The average median diameter of the left side of the heart increases steadily with age in children from two through thirteen years with no sex differentiation. Until the age of seven, the girls' hearts are smaller than the boys', but after the age of eleven the condition is reversed.

The transverse width of the heart varies from [illegible] to 8.2 per cent of the height in boys of from two through thirteen years of age, and from 6.9 to 8.4 per cent of the height in girls of the same ages. There is a closer correlation between height and the size of the heart than between age and the size of the heart.

Approximately one-third of the heart lies to the right of the midline in children from four through thirteen years of age. The transverse diameter of the heart is approximately one-half of the width of the chest in children from two through thirteen years of

age, and there is no change in this relation with increasing age or height. There are four main types of the shape of the heart in children as in adults, but in children the shape of the heart does not bear a constant relationship to the type of body build. Changes from one type of heart to another are uncommon, occurring in only 0.6 per cent of the present series of cases.

Accentuation of the pulmonary artery, even when marked, has not had any pathologic significance in the cases studied. The effect of respiration on the shape of the child's heart appears to depend on the extent of the diaphragmatic excursion. Serial roentgenograms of the same child usually show great uniformity in contour of the shadow of the heart. There was found a strong familial resemblance in the shadow of the heart in one-half of the family groups studied. Microcardia occurred in 3.6 per cent of the group and was of little or no clinical significance. There was a tendency for the heart to become of normal size at the approach of adolescence. Roentgenograms disclosed growth hypertrophy in children as young as five years who did not show any clinical evidence of this condition until they reached the age of nine.

McGuffin, W. H. Colonic malignancy. *Radiology*, Jan., 1928, x, 21–28.

Malignant growths in the colon are found usually after the age of forty-five to fifty, and the patients have usually enjoyed good health up to the time such malignancy is noted. This condition is much more common than is usually considered. Certain sections of the colon are more frequently affected than others, the order of frequency being as follows in the author's series of 50 cases: sigmoid, rectum, cecum, descending, transverse and ascending colon. Development of the growth is comparatively slow. The conditions which require differentiation are: carcinoma, adenomatous and scirrhous types, ulcerative tuberculous colitis, hyperplastic tuberculous colitis, actinomycosis, acute and subacute appendicitis, extraluminal inflammation and adhesions, fecal impaction, extrinsic pressure effects, syphilis, simple colitis, chronic ulcerative colitis, diverticulitis and various benign growths. The percentage of correct roentgenologic diagnoses is fairly high. Tables and roentgenograms are submitted to illustrate certain conditions noted and also as guides to diagnosis.

McMillan, J. C. Spasticity of the colon. *Radiology*, Jan., 1928, x, 35–40.

The roentgenogram with barium meal and barium enema is a very important factor in the diagnosis of colonic spasm. The barium meal is better than the enema, because the condition is one of deranged function and not an organic lesion. Illustrations of roentgenograms show the various forms taken by spasm of the colon and show how clearly these conditions can be differentiated. Three case reports are given in which this method was used to advantage to accurately and quickly diagnose colonic spasm. After proper treatment the return to normal is also shown by the same means. Since pain and tenderness along the regions of the colon are the first signs noticed, and since these symptoms may be mistaken for other conditions, such as chronic appendicitis, this means of examination becomes of much importance in arriving at an accurate diagnosis.

Messeloff, C. R., Shulman, H. I., and Buckstein, J. Cardiospasm in infancy and in childhood. *Am. J. Dis. Child.*, March, 1928, xxxv, 427–437.

Cardiospasm in infancy and childhood is extremely rare. In over 20,000 roentgen-ray studies of the gastrointestinal tract made at Bellevue Hospital over a period of six years there was only one case, in a girl eleven years old. This case is described in detail. A survey of the literature from 1879 to the present reveals only 11 authentic cases. These cases are briefly cited. In the author's case, the cardiospasm followed closely an attack of whooping cough. Roentgen-ray study showed a large six-hour esophageal retention. In this case the remarkable effect of atropine in causing relaxation of the spasm sufficient to permit the contents of the esophagus to empty completely within thirty minutes points to the vagus nerve as the possible underlying cause in this disturbance. The close relationship of the onset of the attack of whooping cough to the cardiospasm may be of significance. The clearest and most convenient means of determining the presence of cardiospasm is by roentgen-ray examination. This shows a smooth contour of the entire esophagus which tapers to a point at its lower end, permitting very little, if any, barium to enter the stomach. The dilatation above the spasm may be of variable degree.

Cardiospasm in infants and in children must be differentiated from several conditions. It is distinguished from pylorospasm and stenosis by the unchanged character of the vomitus, by the absence of visible peristaltic waves of the stomach and by the absence of a palpable tumor. In rumination the vomitus consists of digested food. In cases of stricture there is a history of trauma or of the swallowing of caustics. Roentgen-ray examination will defi-

nitely differentiate the two conditions. An esophageal diverticulum can best be excluded by the roentgen ray. The most effective form of treatment is dilatation of the spasm by means of bougies or by means of the Plummer apparatus.

MONIZ, E., DIAS, A., and LIMA, A. Roentgenography of the arteries and the topography of the brain and skull. *J. de radiol. et d'électrol.*, Feb., 1928, xii, 72–82.

The authors describe their method of injecting opaque liquid into the cerebral vessels of the cadaver through the internal carotid and taking roentgenograms that show the exact localization of all the cerebral vessels. It is not possible to inject the capillaries, but all the vessels down to the capillaries can be injected. Various opaque substances have been used but they prefer sodium or lithium iodide, which have the same opacity, or 70 per cent strontium bromide which has greater penetration. A number of roentgenograms are reproduced showing the localization of the cerebral arteries. A detailed description of the arteries is given, and as there is an artery accompanying each fissure it is easy to localize the convolutions and fissures of the brain from the position of the arteries. The authors think that stereoscopic roentgenography of the arteries will be of great value in localization of projectiles in the brain.

MOONEY, BERNARD R. Ulceration of the colon. *Radiology*, Jan., 1928, x, 29–34.

Since the etiology of chronic ulceration of the colon is better known to-day, diagnosis is more accurate than it was in the recent past. The roentgenogram following barium meal or barium enema is an important aid in this diagnosis. The pathology of these conditions must be kept in mind when studying these roentgenograms. The author submits roentgenograms to illustrate the condition of the ulcerated colon due to various causes, giving especial emphasis to tuberculous ulceration. The barium meal is often of more value than barium enemas, but it is well to use both. The roentgenogram can be used to observe the progress of the ulcerations, and illustrations are given to show improvement in tuberculous ulcerations.

MORRIS, HUGH. Cholecystography by the oral method without the use of capsules. *Brit. M. J.*, Feb. 25, 1928, i, 305.

In the Salford Royal Hospital, Manchester, results were good with the aid of capsules which had been freshly coated with keratin, but after a short period of storage, the capsules passed through the intestine undissolved. An attempt was therefore made to dispense with the use of capsules altogether. The author made use of a modification of the Sproull method. The dye salt was first mixed with white of egg before being added to about 4 oz. of cooked cream of wheat. The idea underlying this was to fix or partially fix the salt until it should have passed through the pylorus. In practically three-fourths of the cases no unpleasant effects were produced from the ingestion of this material. The unpleasant effects were as follows: Headache in 1 case; nausea, 5 cases; diarrhea, 2 cases; vomiting, 1 case. The density of the gall-bladder shadow in this method was found as intense as that found in any other oral method which has been employed at the hospital.

O'BANNON, R. P. Gastric defect produced by a cholecystogastrostomy. *Radiology*, Feb., 1928, x, 162–163.

A fistulous opening following cholecystogastrostomy was found by means of a roentgenogram following barium meal. The barium was found in the gall-bladder, which condition led to a false diagnosis—perforated gastric ulcer. The evidence of gastric defect, as brought out in the present case, was not thought of prior to operation for gastric ulcer. This case offers another example of erroneous diagnosis due to limited study of roentgenograms. The roentgenogram submitted by the author shows the gastric defect clearly.

PENDERGRASS, EUGENE P., and WILBUR, DWIGHT L. Tumor of the brain with widespread metastases. *Arch. Neurol. & Psychiat.*, March, 1928, xix, 437–445.

Distant metastasis from a tumor of the brain is rare, and close study of the literature has failed to reveal a single reported case. The authors have observed 2 unusual cases in which there developed widespread metastases, presumably from a primary brain lesion. Unfortunately, post-mortem examinations could not be made. The first case occurred in a woman aged forty-one suffering from a cerebellar tumor, the final pathologic report being endothelioma. Radiation treatment was applied, combined with roentgen rays. The patient responded well but was never entirely relieved of symptoms. Two operations were performed and radium was implanted into the growth once. The patient was under treatment from 1914, and in the Summer of 1926 she developed metastatic lesions in the lungs and died. An endothelioma of the brain is a malignant growth which tends to destroy and recur. Endotheliomas elsewhere in the body are prone

to metastasize. In this case the growth was exposed and partially removed twice. It is a common surgical experience for metastasis to occur in endotheliomas located elsewhere and treated by repeated operative procedure and irradiation.

The second case occurred in a woman aged thirty-two, suffering from cerebellar dysfunction and increased intracranial pressure. The lesion was a cerebellar tumor. The final diagnosis was glioma (medullary blastoma). This type of tumor is also a malignant and cellular growth. The patient was operated on four times with radium implantation twice, the growth being traumatized frequently. About three years after the first admission there developed growths in the chest and on the back near the sacrum, with metastatic involvement of the pelvis. The growth involved both wings of the ilium and both femors, especially the right, and the right wing of the sacrum.

In neither of these 2 cases could there be discovered a primary tumor other than that in the brain. Even if these cases cannot be accepted conclusively as tumors of the brain with metastasis to distant organs, they are of interest in certain other connections. The first patient responded well to radiation treatment and lived for twelve years after the first treatment. In both cases radium was implanted with the demonstration that such a procedure is safe if carefully employed. Both cases showed evidences of a metastatic tumor which began either from the brain tumor or from some other primary lesion that could not be discovered.

Pendergrass, Robert C., and Clark, James J. Thoracic aneurysm: Report of case. *Radiology*, Dec., 1927, ix, 512–515.

Teleroentgenograms were used to follow the course of the development of a thoracic aneurysm. One illustration shows the destruction of ribs, while the other two show the rapid progress made in the development of this aneurysm.

Pierson, Philip H. A pathological study of x-ray shadows of chronic pulmonary tuberculosis. *Am. Rev. Tuberc.*, April, 1928, xvii, 331–335.

A report is given of work undertaken to study and visualize the pulmonary disease causing the death of a tuberculous patient aged sixty-four. The body was received thirty-six hours after death, and roentgenograms were taken in the posteroanterior projection, at a distance of 5 ft. The roentgenological examination showed a large mass of air in the upper portion of the left chest. Some of this seemed to burrow into the lung; but over a large part of the outer surface no lung tissue could be seen. There was what looked to be quite obviously a cavity in the right apex and there were some suspicious annular shadows of small size in the lower lobes. There was a great deal of fuzzy density scattered in a feathery sort of way through both lung fields; this was suspected as post-mortem change.

The body was embalmed and the thorax severed and frozen. A mitre was constructed to permit cutting sections of the thorax on a 5-ft. radius, following the plane of the roentgen rays. These sections measured approximately 1 to 2 cm. in thickness anteriorly, and slightly less posteriorly. A study of any one of these sections showed the disease represented by the superimposed shadows in the corresponding strip of the roentgenogram.

This method permits the careful study of all the disease in a given section of the roentgenogram, including that which is otherwise obscured by the heart and diaphragm. It also permits visualizing parts of the heart in the roentgenogram.

Sansum, W. D. The ethmoidal and sphenoidal sinuses as sources of focal infection. *Radiology*, Nov., 1927, ix, 410–414.

Many pathological conditions have been traced to infection of the ethmoidal and sphenoidal sinuses. Chronic arthritis, neuritis, migraine, peptic ulcer, etc., have been traced to such foci of infection. The present paper is based on a study of 109 cases, but of this number only 8 typical case reports are given. These are cases of chronic arthritis, neuritis, chronic parenchymatous nephritis, migraine, malnutrition, recurrent peptic ulcer and lumbago. The aid of the roentgenologist in the diagnosis of the source of infection which brings about these conditions is shown to be an important asset in the study of these diseases. When these foci have been treated and the infection alleviated, the distressing symptoms have been relieved.

Sante, L. R. Nontuberculous intrathoracic conditions. *Am. Rev. Tuberc.*, May, 1928, xvii, 489–499.

The roentgenographic characteristics of lobar pneumonia are described. It would hardly seem possible that lobar pneumonia could be confused with tuberculosis, yet there is a form of tuberculous lobar pneumonia which is similar in all respects to pneumonia of pneumococcus origin. Clinically and even roentgenographically these forms may be indistinguishable. This form of acute caseous tuberculous pneumonia seems to occur in patients showing little, if any, evidence of

previous tuberculosis. Not until the time for crisis is long past is the tuberculous nature of the disease suspected. True lobar pneumonia causes no actual destruction of tissue so that resolution is prompt, leaving the lung structure intact; caseous tuberculous pneumonia causes destruction of lung tissue, resolution always takes place with cavity formation and healing is by fibrosis. Not until the stage of destruction do tubercle bacilli appear in the sputum. At this time evidence of extension of the infection also becomes apparent in the roentgenogram.

In lung abscess the tuberculous and non-tuberculous forms may resemble each other roentgenographically to such an extent that the finding of tubercle bacilli in the sputum may be the only means of differentiation. A condition of chronic interstitial pneumonia may be entirely of pyogenic origin, or may be the result of extensive tuberculous infection. The roentgenogram may be almost the same in both instances. When the condition is the result of tuberculosis, however, there is usually evidence of extension of the disease to the opposite lung; when the condition is not the result of tuberculosis, the opposite lung remains free from disease even for years.

In massive atelectatic collapse of the lung, the roentgenographic picture is in all respects similar to chronic interstitial pneumonia except that no bronchiectatic cavities are involved. This condition is acute and is not preceded by other pulmonary disease. It is not likely that this may be confused with any of the ordinary types of tuberculosis, but it is possible that it might be mistaken for the acute caseous tuberculous variety.

Primary tumors of the lung may, because of their insidious onset, be suspected of being tuberculous disease. This is especially true of the diffuse type of primary carcinoma of the lungs which progresses slowly, gradually invading larger areas of lung tissue; such tumors sweep on across intervening pleural septa and present an infiltrating hazy border. While they may, after months, show some tendency to disintegrate and form cavities, the cavities thus formed are always small in comparison with the extent of pulmonic consolidation, and are always more ragged and irregular than those encountered in tuberculous pneumonia. The uniform dissemination of small infiltrations throughout both lungs, such as that encountered in the disseminated form of pulmonary or miliary tuberculosis, may be encountered in the second stage of silicosis, miliary carcinomatosis or bronchiolitis. The clinical history may be decisive in differentiating these conditions.

Pleural effusions is one of the conditions upon which a diagnosis of pulmonary tuberculosis may be based, but these effusions may be of non-tuberculous origin. Tuberculous effusions bear no distinctive characteristics. However, they usually consist of thin serous fluid and rarely tend to pocketing. Any tendency of fluid to become localized is presumptive evidence of its non-tuberculous nature. Spontaneous pneumothorax is also a frequent complication of tuberculosis but it is likewise frequently encountered in non-tuberculous disease. The roentgenographic examination shows something of the condition of the collapsed lung and often locates the cavity which gave rise to the pneumothorax.

SOSMAN, MERRILL C. Radiology as an aid in the diagnosis of skull and intracranial lesions. *Radiology*, Nov., 1927, ix, 396–407.

The skull is subject to the same diseases and injuries as any other bone and these lesions can be observed very well by means of the roentgenogram. Fifteen cases are illustrated with roentgenograms which show clearly lesions of the skull and intracranial area. About one-third of the intracranial new-growths can be observed by careful roentgenologic examination.

STEPHENS, V. R. Acute intussusception. *Am. J. Dis. Child.*, January, 1928, xxxv, 61–64.

Manipulative reduction by roentgenoscopic control should be attempted in early and moderately advanced cases of acute intussusception. The degree of severity does not depend on the time element alone and the resultant opportunity for agglutination of surfaces, but on the extent of the process and the firmness of the incarceration, with resulting interference with the circulation. The author has reduced intussusception in 2 cases by manipulation, with perfect results. One case is cited.

The method is as follows: Fill the colon with barium as far as the intussusception, using a large colon tube and avoiding leakage. It is not advisable to allow any barium to escape, as it blurs the field of observation and tends to increase the invagination. Admit only a small amount at a time, work slowly and manipulate gently at the point at which the enema meets the intussusception. If there is much gas obscuring the outline of the head of the intussusception, allow the first enema to escape with the gas, keeping the patient in a horizontal position, and refill. Do not depend on the barium pressure to reduct the intussusception, but admit just enough to keep the colon well filled to the point at which reduction has been accomplished. Be sure that the caput coli is filled. A generous trickle into the ileum is

important evidence of complete reduction. A relaxed or incompetent ileocecal valve may be an etiological factor in this type of intestinal invagination. If there is doubt concerning the completeness of the reduction, open the abdomen at once. In the open abdomen, it is a simpler procedure to reduce a mass that extends no further than the hepatic flexure, than one which has invaded the sigmoid and produced a partial volvulus of that flexure. The method is similar to that of Retan except that the author depends, on one hand, to do the manipulating and, on the other, to control the flow of barium in the tube so as to fill quickly the space vacated by the manipulation. By keeping one hand continuously on the colon tube to hold it in place, delay and annoyance due to expulsion of the tube are avoided.

STOLOFF, E. GORDON. Acute massive atelectasis of the lung, complicating a fresh tuberculous primary complex. *Am. J. Dis. Child.*, February, 1928, xxxv, 239–249.

Acute massive atelectasis of the lungs is considered as being caused by some disorder centered primarily about the bronchus. It may be an intrabronchial obstruction, an extrabronchial obstruction or an idiopathic obstruction. The intrabronchial and extrabronchial obstructions may be of the by-pass valve type, the check valve type or the stop valve type. A case is presented of a girl aged two, who suffered acute massive atelectasis of the lung resulting from extrabronchial as well as intrabronchial causes. The basic cause of the atelectasis was an enlargement of the regional lymph nodes caused by a fresh primary tuberculous complex, this enlargement being marked enough to occlude the already inflamed bronchus with subsequent atelectasis of the lung. Plugs of exudate or mucus may also have been present. The roentgenograms showed two shadows present constantly throughout the course. One was in the field of the left lung in the lower part of the left upper lobe. It was about the size of a dime, of increased density, and more or less sharply circumscribed. This was probably the primary tuberculous focus. The second shadow was in the region of the hilum, fairly dense and fan-shaped, located opposite and slightly above the level of the first shadow mentioned. The second shadow probably indicated the disease of the regional lymph gland. There were also present shadows of varying extent which appeared and disappeared around both parts described, and these were caused presumably by perifocal inflammation. In view of the age of the patient and the strongly positive Pirquet reaction, a diagnosis of a fresh tuberculous primary complex was justified. A subsidence in the extent of the inflammation caused a return of the patency of the bronchus with restitution and reaeration of the lung. A diagnosis of dilatation of the heart is not infrequently made when the massive atelectatic process is not on the left side for the heart is displaced so that the apex is far from its normal limits. This error was made in the present case. It was not considered advisable to perform bronchoscopy because of the age of the child and because the condition improved rapidly.

SUTHERLAND, CHARLES G. The differentiation of osteitis deformans and osteoplastic metastatic carcinoma. *Radiology*, Feb., 1928, x, 150–152.

Because of the difficulty of differentiating, roentgenologically, between osteitis deformans and metastatic carcinoma and because the prognosis of the two conditions is entirely different, a careful study of the points of difference is very important. The lesions of Paget's disease are most commonly seen in roentgenograms of the spine and pelvis, the head, the femur and the tibia, and may affect nearly all the bones. The thickening of the cortex, of the femur, the striated appearance of the bone shadow and the multiple cysts in the ilium are characteristic. In osteoplastic metastatic carcinoma, on the other hand, there is absence of thickening of the cortex of the femur, the bone shadow presents a coarsely granular appearance, and absence of any apparent increase in volume or thickness of the bone is characteristic. Roentgenologically, the earliest evidences of metastatic carcinoma from the prostate are noted in the ilium along the margins of the sacroiliac synchondrosis. There may be "spottings" of increased density on a background of apparent destruction of bone. Since osteitis deformans is not recognized in the very early stages, the lesion is always more widespread. If the process has extended to the femurs, the lesion becomes characteristic, due to the subperiosteal layers of new bone marrow into fibrous tissue, widening of the cortex and an irregularly striated appearance of the bone over the medullary portion. In osteoplastic metastasis there is no widening of the bone, but diffuse, homogeneous increase in density with "spottings."

Osteitis deformans is attended with little pain, and this of a mild rheumatic type, while the pain of metastasis is constant and progressively increasing in severity.

SWANSON, W. W., PLATOU, E. S., and SADLER, W. Congenital cyst of the lung. *Am. J. Dis. Child.*, June, 1928, xxxv, 1024–1031.

A report is given of a case occurring in an infant girl ten weeks old, referred for treatment of malnutrition as well as abnormal breathing. The breathing was of an obstructive type, with moderate retraction in the supraclavicular and epigastric regions. There was impaired resonance over the right side of the chest, particularly in the mid-axillary line. In this area there was also suppression of breath sounds. The left side of the chest presented signs of a compensatory emphysema. The roentgenogram on admission showed a dense opacity throughout the whole right hemithorax, with some areas of clearance near the base at the periphery. There was marked displacement of the heart and mediastinal structures to the left side. A considerable amount of fluid was aspirated by thoracentesis.

The procedure had to be repeated often in order to give the patient relief. After withdrawal of the fluid, roentgenograms showed the lung partially collapsed and a large amount of air in the pleural space. Areas of rarefaction were also noted in the collapsed lung. Introduction of 5 c.c. of sodium iodide into the cystic area showed some of the contrast material clearly below the dome of the diaphragm. When 60 c.c. of sodium iodide was injected into the cyst a clear outline of the whole lung and its various lobes could be distinguished. None of the solution passed into the pleural space, and there was no evidence of any connection between the lung and esophagus or any other structure in the mediastinum. A lateral view indicated that the sodium iodide occupied the entire anteroposterior thickness. After about five months of treatment the cyst decreased in size so that it would hold only about 5 to 8 c.c. of solution. It was thought that bronchoscopy and injection of iodized oil would be of help in determining a possible relation between the cyst and one or more bronchi, and also whether smaller cysts might not be present. There was considerable filling of alveoli of the lung with iodized oil, indicating that the lung was fairly well aerated at the time. The cyst was shown as a clear area about the catheter. No definite connection was apparent between the bronchi and this cyst. Unfortunately the infant did not do well after bronchoscopy and died in forty hours. A microscopic study of the cyst wall indicated that it originated from a bronchus.

TAYLOR, HENRY K. Chronic osteitis simulating osteogenic sarcoma. *Radiology*, Jan., 1928, x, 62–69.

This is a case report of chronic osteitis which was incorrectly diagnosed as osteogenic sarcoma. The roentgenograms were studied by different roentgenologists who gave the same diagnosis. After excision, it was found that the lesion was not malignant, but was chronic osteitis. This condition is rare, the symptoms, age of patient, history of trauma, long interval of time of development, etc., pointing toward a diagnosis of sarcoma. However, this report is an example of exceptions which must be watched for, and a warning that surgical procedure should not be radical unless there is absolute certainty that such procedures are necessary.

ULLMANN, H. J. Roentgen diagnosis of nasal sinus disease. *Radiology*, Nov., 1927, ix, 408–409.

Routine roentgen examination of the nasal sinuses is just as important as it is of the teeth in cases of focal infection. Sphenoidal pathology is as important as the pathology of the other sinuses, but is usually overlooked. The Granger method must be followed in detail in order to obtain results. Positive roentgen findings are quite common when rhinological examination is negative.

WEYMULLER, CHARLES A., BELL, A. L. L., and KRAHULIK, LAMBERT. Roentgenographic changes in the thorax of normal new-born babies. *Am. J. Dis. Child.*, May, 1928, xxxv, 837–855.

A report is given of a daily roentgenographic study of 25 normal babies during the first fourteen days of life. The infants were of average weight and did not have any detectable physical defects. Complete physical examination was made each day with particular attention to the question of abnormal pulmonary or cardiac signs. If the infant developed fever, lost an unusual amount of weight or in any way differed from the average, the roentgenograms were excluded from the series. A small frame was built in which the infant could be immobilized during the roentgenography. The factors used for the exposures were: 5 in. spark gap, 30 ma., 26 in. distance, exposure for $\frac{1}{50}$ sec.

Sharp definition between daily roentgenograms of the first two weeks was not found, but a certain progression and regular occurrence of a number of interesting shadows were noted. Among these shadows were the linear markings extending far toward the parenchyma of the lung. These were usually less distinct after the first three days but they were at all times sufficiently dense to be misinterpreted as pulmonary disturbance. It may be that these striking linear shadows represent a low degree of pneumonia, although the babies appeared to be perfectly normal.

Accurate measurements of the size of the

cardiac shadow was technically impossible. Moreover, the great individual variations in size and in cardiac contour made classification and description useless. The striking facts observed were the fairly regular tendency toward reduction in the size of the cardiac shadow after the second day and the finding of a huge heart shadow in an apparently normal infant. In the latter instance the shadow occupied almost the entire thoracic cavity during the first two days of life without causing any untoward symptoms; subsequently the cardiac shadow decreased to a size similar to that of the other infants of the same age.

The width of the upper mediastinal shadow often changes most markedly with respiration, and in certain instances changes to the extent that it might readily be confused with the shadow interpreted as an enlarged thymus gland. This is particularly true if but a single film is seen and if that film is taken during expiration.

To summarize: The roentgenograms made during the first twenty-four hours usually show more dense linear pulmonary markings which extend further toward the parenchyma than on the second to the fourteenth day. The interlobar pleural line between the right upper and middle lobes is almost regularly seen on the first day and varies little in density thereafter. The cardiac shadow is relatively larger on the first and second days.

Wilkie, D. P. D. Some aspects of gall-bladder disease. *Brit. M. J.*, March 24, 1928, i, 481–484.

Infection of the gall-bladder is probably the cause of many abdominal maladies, particularly among persons of sedentary habits. It is usually an intramural blood-borne streptococcal infection, and is frequently associated with the formation of gallstones. If neglected, serious and often fatal complications may ensue. When firmly established, the disease can be cured only by radical surgery. In the absence of secondary changes and complications such as malignant disease, pancreatitis, hepatic cirrhosis and insufficiency or toxic myocarditis, operation has a low mortality, and the results as regards subsequent health are very good. Elderly patients may be safely operated on under twilight sleep and local anesthesia.

In quite a large proportion of cases of cholecystitis, it is found at operation that the bile in the gall-bladder is normal in appearance and is sterile on culture, and if withdrawn by the duodenal tube could not possibly have indicated the intramural infection present in the submucous layer of the gall-bladder. Consequently diagnosis by means of the duodenal tube is of uncertain value. On the other hand, cholecystography, if interpreted intelligently, is of the greatest help in diagnosis. If a dose of not more than 3 gm. intravenously or 4.5 gm. by mouth be used, no untoward effects are produced and the functional capacity of the gall-bladder can be gauged with a fair degree of accuracy. From an experience of more than 200 cases, the author declares that it transcends all other methods of diagnosis and gives reliable data in over 90 per cent of cases. It is of special value if used in conjunction with a barium meal, for then it may reveal a normal gall-bladder and a deformed duodenal cap in a patient presenting the cholecysto-duodenal syndrome.

The dye test is seen to greatest advantage in cases where cholesterin calculi are present in a gall-bladder with patent cystic duct. Then the negative shadows cast by the calculi enable not only a positive diagnosis of gallstones to be made, but give accurate information as to the type and number of calculi present. In a few cases in which the clinical history pointed to cholecystitis, it was found that the gall-bladder shadow appeared to be practically normal, yet at operation a gall-bladder with opacity of its wall and with enlarged cystic gland was found, and from both gall-bladder wall and the gland, streptococci could be cultivated. This simply means that in the early stages of a chronic cholecystitis, the gall-bladder function is maintained at a sufficiently high level to allow of an almost normal concentration of the dye.

ROENTGEN AND RADIUM THERAPY

Greenough, Robert B. Progress and prospect in treatment of cancer. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 159–160.

The Committee on the Treatment of Malignant Diseases with Radium and X-ray of the American College of Surgeons is attempting to make available for study a portion of the great mass of surgical material in this country which may aid in providing an answer to some of the disputed points in regard to the treatment of cancer in its more important situations. To provide a uniform basis of study the committee is attempting to do two things: (1) to establish a uniform method of classifying and recording cancer cases of the more important regions of the body, and (2) to establish criteria which could be accepted in every clinic in regard to the inclusion or omission of case records for consideration.

One preliminary report of the three-year end-results of the treatment of cancer of the cervix was published in 1924. At the present time two reports are in preparation: (1) the cervix cases are being carried to a minimum five-year end-result, and (2) material for a report on cancer of the breast on a minimum five-year basis is being analyzed. Abstract cards for three other forms of cancer have been prepared and the collection of records for cancer of the mouth and tongue, cancer of the rectum and cancer of the ovary have been begun. Similar cards for cancer of the colon and of the thyroid are in preparation.

What is true of the surgical treatment of cancer is likewise true of its treatment by roentgen rays and radium. Not every patient obtains treatment from a radiologist whose greatest interest is in therapy. Many treatments are given with inadequate apparatus and many in a perfunctory manner that offers little advantage to the patient. Especially in regard to radiation therapy is to be noted the frequent lack of accurate records and of an effective follow-up system. It is again these facts which justify the special cancer service in the general hospital where the roentgen and radium therapeutist can join with the surgeon, the pathologist and the specialist in the other branches of medicine in consultation and coöperation, with a view to giving to each individual cancer patient the treatment or the combination of treatments best suited to that individual case.

GRUSCHETZKAJA, M. The roentgen therapy of laryngeal papillomas. *Strahlentherapie*, 1926, XXV, 420–426.

The roentgen therapy of laryngeal papillomas is a relatively new branch of roentgen therapy. The author reports briefly on the results obtained in 7 cases which were observed up to three years. The treatment in 5 of the cases resulted in complete and apparently permanent cure, with disappearance of the papillomatous growths and absence of recurrences up to three years. In all of these 5 cases previous operations had been unsuccessful. In another case previously unsuccessfully operated upon, roentgen treatment produced an immediate cure but the patient was lost from sight.

In one case the roentgen treatment produced a considerable decrease in size but not entire disappearance of the papilloma. The roentgen technique was as follows: 180 kv., 4 ma., 0.5 mm. Zn plus 1 mm. Al. Each series consisted of two exposures. The first exposure covered the larynx from the right and the second from the left, at a focal skin distance of 23 cm., portal 6 × 8 cm. The dose consisted of $\frac{1}{2}$ skin erythema unit (6 H) per field. The interval between the first series and the next was six weeks, and between each following series the pause was increased. The number of series in the present group of cases varied from two to five. No disagreeable symptoms made their appearance after an irradiation; nor have there appeared any signs of late reactions, not even a pronounced pigmentation of the exposed skin. The results seem to show quite convincingly that the roentgen treatment of laryngeal papillomas seems to promise a prompt and certain cure which seems to be permanent. With proper roentgen technique there is no risk of any disagreeable or dangerous after-effects.

HEYMAN, J. Radiological or operative treatment of cancer of the uterus. *Acta radiol.*, 1927, VIII, 363–409.

The number of cases hitherto submitted in various statistical reports concerning the radiological or operative treatment of cancer of the cervix uteri are sufficient to enable a comparison to be made between the absolute results obtained by the two methods. In drawing definite conclusions, however, from such a comparison difficulties are encountered because of the fact that the results of the operative treatment have been obtained from an initial material which was, on the whole, qualitatively far superior to that treated radiologically. On the other hand, the number of cases submitted is still too small to permit any definite conclusions as regards the results in the treatment of operable cases of cancer of the cervix only, as well as cancer of the corpus.

Cancer of the Cervix Uteri. An endeavor has been made to collect all complete statistics from the world literature pertaining to the results of extended operations of cancer of the cervix uteri. These statistical series which include the ultimate results of the operative therapy have been partly recomputed on uniform principles for the purpose of deducing what has been really accomplished by the extended operations. The highest average figure that can be reasonably inferred as representing the absolute result in operations from statistics hitherto published is 20.2 per cent. The statistics from the Radiumhemmet includes 500 cases of carcinoma of the cervix uteri treated radiologically in the first instance, and 41 cases not treated. The lowest figure for the absolute results that can be deduced from this group of cases is 20.7 per cent.

In two-thirds of the operative statistics referred to, the number of operable cases was 58.6 per cent or greater; in the group from the Radiumhemmet there were 26.6 per cent operable cases. With due regard to this difference in the initial material, it would seem

that the radiological treatment as practised at Radiumhemmet in respect to absolute results in the treatment of cancer of the cervix uteri is superior to the operative treatment. As to the results of treatment of the operable cases alone, the radiological statistics are still too small to permit a comparison with the results from operation. Figures so far available lend no support to the assumption that operative therapy in these cases would accomplish more than radiological treatment.

Cancer of the Uterine Body. The figures hitherto published regarding operative as well as radiological treatment of the corpus are still far too small and incomplete to permit any definite conclusions to be drawn. Operative statistics show the absolute result to average 42.8 per cent of all the cases and 58.8 per cent among the operable cases. The statistics from Radiumhemmet includes 46 cases with an absolute result from radiological treatment of 43.5 per cent, and among these cases classed as operable the percentage recovery was 60.0 per cent. These figures seem to indicate that the same results, at least, can be attained with radiological as with surgical treatment.

HIGGINS, CHARLES C. Malignant tumors of the testicle. *Ann. Surg.*, February, 1928, lxxxvii, 263–291.

Most malignant tumors of the testicle may be classified in two groups: teratomas or mixed tumors, and spheroidal cell tumors. As we now know, sarcomas of the testicle are quite rare. Of the 23 cases of malignant tumors reported by the author, 5 are carcinomas, 2 sarcomas, 5 teratomas and 3 embryomas. In 8 cases the type was not specified, in 4 of them no operation was performed. The tumors appear most frequently during the age of greatest sexual activity, that is, between the ages of twenty and fifty; however, no age is exempt. In the author's series the youngest patient was twenty-one, the oldest fifty-three and the average thirty-four. In many cases the patient gives a history of trauma, but this is frequently merely the incident that causes the patient to note an enlargement which is already present. The presence of a pre-existing tumor cannot be excluded as a possible cause and such a tumor may be stimulated by trauma to more active growth. In the same manner constant pressure and irritation may exert a similar influence upon an undescended testicle lying in the inguinal canal.

There are no pathognomonic signs or symptoms of malignant tumor of the testicle. In fact, the diagnosis is occasionally reached by a process of exclusion. In making a differential diagnosis, hydrocele, hematocele, gumma and tuberculosis must be considered. In its early stages, a malignant tumor of the testicle is firm and smooth and causes no change in the contour of the testicle, although nodulation may occur later. The epididymis is usually palpable and is clinically free from change. The testicle cannot be transilluminated. In many cases because of the slow development of the swelling and the absence of pain, the patients do not consult a physician until metastases are present. In the present series of cases, the average time elapsing between discovery of the swelling and consultation was ten months.

Many types of treatment for malignant growths of the testicle have been attempted: orchidectomy followed by roentgen treatment, by radium packs and by Coley's serum; orchidectomy followed by radical resection of the gland; roentgen therapy or radium therapy alone. In determining the advisability of performing the radical operation, one point must be emphasized—the radical operation should not be attempted if the enlargement of the glands can be recognized clinically. Roentgen therapy is preferable in these cases. When the glands are palpable they are enlarged to such an extent that their removal is impossible. The author believes that roentgen treatment should be administered to the testicle prior to orchidectomy and that following orchidectomy roentgen therapy should be applied systematically to the inguinal region and to the lumbar and left supraclavicular regions. Close observation and very frequent examinations are essential. Whatever the type of treatment, the prognosis in cases of malignant tumor of the testicle is grave. However, by radium, roentgen ray and Coley's serum the course of the disease may be abated and a decrease in the size of the metastatic lesion may be secured. The details of the 23 cases are briefly cited.

KAPLAN, IRA I. Radiation treatment of malignancy of the cervix by radium emanation. *Radiology*, October, 1927, ix, 314–321.

The method of treating carcinoma of the cervix in vogue at Bellevue Hospital at the present time is as follows: the lesion is treated, first, by attacking it locally to clear up the infection, then the pelvis to block off the lymphatics and destroy the metastatic foci, and finally the local lesion, with the idea of destroying the tumor and to give a sufficient dosage in the proper time to give the desired result. The patient is first treated from a hygienic and nutritional standpoint before irradiation is started. The bowels are cleansed

with enemas, douches with boric acid or 2 per cent glucose solution are then followed by irrigation with 2 per cent methylene blue to clean up the infection. A biopsy is then taken of the lesion. In all cases deep roentgen-ray therapy is used over the pelvis as follows: 200 kv., 4 ma., 30 to 50 cm. target distance, 0.5 mm. Cu and 1.0 mm. Al filter, 9 × 12 or 15× 15 cm. portals. Usually two portals anteriorly and two posteriorly are treated. If the bladder is involved, a central portal is also given over the pubic area. The treatment is given in divided doses, alternately. The first day anterior right and left pelvis is treated with 25 per cent of the erythema dose and then the next day the posterior pelvis right and left, and so on until four or five doses have been given. This gives a depth dose of 60 to 75 per cent on the lesion.

The radium treatment depends on the histopathology, the amount of involvement and extension of the lesion and whether or not the uterine canal is open. The dose varies from 4,000 to 7,000 mc-hr. If the lesion is limited to the cervix, 4,500 mc-hr. is given, half in the cervical canal and half in the vagina. A modified "colpostat" is used in these applications. If necessary, radium puncture and endothermic surgery are also performed. This system of treatments has been very successful during the two years it has been in practice in Bellevue Hospital.

KRANTZ, CLEMENT I., and RIDDLE, MATTHEW. The basal metabolism in chronic lymphatic leukemia. *Am. J. M. Sc.*, February, 1928, clxxv, 229–242.

The study of the basal metabolism and the formed elements of the blood in 31 cases of chronic lymphatic leucemia leads to the following conclusions. The basal metabolic rate in this disease is elevated when the leucemic process has progressed far enough to cause other than local symptoms. The rise in the basal metabolic rate is not closely related to the height of the leucocyte count when a group of cases is considered. In individual cases the basal metabolism and leucocyte count vary simultaneously in a similar manner after roentgen-ray or radon treatment. A dose of 250 or 500 electrostatic units of roentgen rays often produces a marked decrease in the leucocyte count. A short transitory rise in the basal metabolism is often found within three days after the application of such treatment. The elevation of the basal metabolic rate appears to be less labile than the leucocyte count, and it is more directly comparable with the patient's symptoms than with the white blood cell count.

The presence of considerable numbers of distinctly immature lymphocytes is usually associated with an increased energy exchange. When irradiation causes but slight or no decrease in the numbers of these cells the basal metabolism usually does not fall to normal and it soon returns to its former level. The determination of the basal metabolic rate is a valuable guide in the treatment of patients with roentgen rays or radon particularly when the white blood cell count is low. Patients with lymphatic leucemia should be treated with roentgen rays or radon only when there are adequate reasons for doing so. The treatment of this disease is not limited to radiation therapy alone, but the latter does improve the patient symptomatically for a time and when the disease is not too far advanced he may be able to resume his normal activities until the disease process once more gains the upper hand. There are certain definite indications for radiation treatment which may be of benefit: (1) Indications for treatment directed towards the patient's general condition: (*a*) when symptoms of elevated energy exchange occur or when the basal metabolism is elevated above normal, provided irradiation is not contraindicated because of recent exposure to roentgen rays or radon; (*b*) when the white blood corpuscles are 100,000 or more per cubic millimeter. (2) Indications for treatment directed toward a local condition when pressure from diseased tissue causes symptoms. Contraindications for radiation therapy: (1) When the bone marrow is markedly involved in the disease process so that anemia and thrombopenia are produced; (2) when the circulating blood contains large numbers of very immature lymphocytes; (3) when recent adequate therapy has not benefited the patient. As to dosage, a suberythema dose of 1000 to 1200 electrostatic units should not be applied to the same region more often than every five or six weeks.

MILLER, C. JEFF. The management of chronic endocervicitis. *Surg., Gynec. & Obst.*, March, 1928, xlvi, 337–340.

Endocervicitis is an infectious disease which does not tend to cure spontaneously and the sequelae of which may be extremely serious. Every case therefore demands prompt treatment. Any treatment to be successful must be directed toward the underlying pathology rather than toward the manifestations of the disease, and this pathology cannot be clearly realized unless there is an accurate comprehension of the histology of the cervix and lymphatic circulation of the pelvis.

Local treatment is very unsatisfactory and

diathermy, ionization, alcoholic injections and similar measures give only partially satisfactory results and are not free from danger. Radium often gives excellent results in selected cases but is too dangerous to be employed routinely. If it is used, it must be strictly limited to those cases in which it can be definitely demonstrated that no active or latent infection of the tubes is present, and even to an expert such a decision is not always easy to make in the face of a badly infected cervix and the possibilities of an upward extension of the infection.

Prophylaxis, especially soon after parturition, will avert a large proportion of cases. According to the conditions present cauterization, trachelorrhaphy, the Sturmdorf operation or complete amputation must be done, although the latter procedure should be avoided whenever possible. Any surgery is best preceded by a preliminary course of treatment, the object being to reduce hypertrophy and inflammatory reaction in the structures and to restore the normal relations of the parts.

Nemenow, M. J., Arnstamm, O. J., and Nowotjelnowa, E. R. The roentgen and radium treatment of gynecological cancer. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 989–990.

Since 1919 the authors have observed 1,030 cases of cancer of the female genitals which were treated by roentgen rays and radium. These cases were distributed as follows: 658 cancer of the neck of the uterus; 50 cancer of the body of the uterus; 14 carcinoma of the vagina; 25 cancer of the ovaries; 273 recurrences after war-time operation; 10 recurrences after removal of the ovaries. On the basis of this material, the authors conclude that in operable cases the radiation treatment is generally not inferior to the surgical and when applied by an experienced radiologist with a utilization of all modern improvements in technique, radiation therapy can be applied to such cases quite as satisfactorily as surgery. In all inoperable cases and in cases on the borderline, a systematic combined treatment with radium and roentgen rays should be pursued by and applied only by a specialist. By means of this procedure about 10 per cent of inoperable cases were saved from apparently unavoidable death. In the hopelessly inoperable cases, the radium-roentgen treatment, although not expected to yield a cure, is quite definitely useful for palliation.

As regards technique of treatment, the authors never resort to curettage or removal of the tumor by means of the Paquelin technique because experience has shown that these affect the final results unfavorably. As a rule, a test excision is taken for purpose of biopsy and treatment begun at once. Radium in the form of the bromide is applied, 25 to 50 mg. radium element previously filtered through 1 mm. brass or gold but from now on through 2 mm. platinum. More recently five preparations have been used, each containing 10 mg. radium element. Depending on the quantity of radium in the applicator, the latter is inserted in the neck of the uterus and at some distance from the crater and allowed to remain twenty-four to forty-eight hours. After five to eight days, the radium treatment is repeated and according to the case three times and occasionally four times. In this manner the patients receive during a series 2500 to 4000 mg-hr. of radium. Considerable rise in temperature over 38°, tenesmus, complications in the bladder are indications for immediate removal of the radium. In the intervals between radium treatments, the patients receive roentgen irradiations, 200 kv., 0.5 mm. Zn plus 3 mm. Al, or 0.8 mm. Cu plus 3 mm. Al, portals 10 × 15 cm., or 20 × 20 cm., focal skin distance 30 to 40 cm. One field is applied anteriorly, a second from the back and one field over each foramen ischiadicum. If necessary, a fifth exposure is given over the perineum. Under these conditions the tumor receives 100 to 125 per cent of the skin erythema dose. The whole radiation series is repeated after two and a half to three months and, where necessary, a third series is given four to six months after the second.

Neumark, S., and Kryński, A. The treatment of lichen ruber planus by roentgen irradiation of the spinal cord and the sympathetic ganglia. *Strahlentherapie*, 1927, xxv, 427–442.

A report is given of the results obtained in 8 cases of lichen ruber, one of which had been previously treated locally with salves and roentgen rays but without much improvement. It was decided to test the value of roentgen treatment of the spinal cord and sympathetic ganglia. Only the interscapular and lumbar regions were exposed to small doses administered a few times at intervals of four weeks. The radiation technique was as follows: 28 to 30 cm. spark gap, 2.5 ma., anticathode skin distance 25 to 30 cm., single dose 3 to 6 H filtered through 3 to 4 mm. Al. In some cases, only the upper or the lower section of the spine was exposed, depending on the localization of the disease process. The position of the roentgen tube was perpendicular to the spinous processes. The 8 cases are briefly cited. The treatment resulted in complete cure in

3 cases; considerable improvement in 3 cases; 2 cases of lichen planus corneus and verrucosus of the leg showed no noticeable improvement.

It may be stated that irradiation of the spinal cord and sympathetic ganglia is successful in cases of general subacute exanthem but it is less satisfactory in cases of lichen planus localized in the lower extremities and the penis; it seems to be unsuccessful in controlling lichen planus corneus and verrucosus of the leg. In all cases except the two failures, the irradiation caused a disappearance of the itching after which there occurred a regression of the local lesion. Immediately after irradiation the itch became stronger but it decreased in a few days. In 2 of the cases the increased itch was accompanied by a distinct exacerbation of the local foci. A technique of irradiation is not yet settled since improvements seem to be possible. Apart from the practical interest in this method of treatment of lichen ruber, it is possible that it may lead to an elucidation of the still obscure pathogenesis of this disease.

SCHMITZ, HENRY. The relation of the degree of the histological malignancy to the prognosis and treatment of carcinoma of the uterine cervix. *Radiology*, October, 1927, ix, 322–332.

Roentgen-ray and radium treatment of cervical carcinomata should be used according to the clinical grouping and histological malignancy index. Carcinomata which offer poor prognosis should not be treated with radiations. Other cases give every hope of being arrested by combined treatment with roentgen rays and radium.

Clinical grouping and histological malignancy index are discussed in some detail.

STEVENS, ROLLIN H. Methods of radiation therapy in dermatology. *Radiology*, October, 1927, ix, 269–279.

The author discusses first the rays which can be used in irradiation of the skin for various affections and gives a table in which these are classified. He then discusses the various skin diseases and indicates whether or not irradiation is beneficial or harmful, and in what way it is contraindicated. He shows that radiation therapy, when properly selected and applied, is of great value in a large number of skin diseases, but that careful diagnosis by competent dermatologists is necessary. The etiology of the disease must be sought and removed if possible. Radiation is not a cure-all, and in fact there are many conditions in which much harm is done.

ULLMANN, H. J. Lead treatment of cancer. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 119–122.

The author has been using the lead treatment for cancer for less than two years but results in cancer of the breast have been encouraging. The suitable lead orthophosphate is used in preference to the more toxic and unsuitable colloidal lead. He does not believe that the lead treatment should at present take the place of surgery and radiation, but it should be reserved for those unfortunates beyond the reach of these treatments. In order to obtain the maximum benefit, it is necessary to combine the roentgen ray or radium with the lead injections and it is therefore absolutely essential that the user be not only a good clinician but a radiologist as well, or be in close coöperation with a competent radiologist. Most patients tolerate lead very well, but there are some who are easily poisoned and present a serious problem.

From the author's experience the only direct contraindication to the use of lead phosphate seems to be severe anemia and perhaps also long involvement not secondary to breast carcinoma. The author's technique at present consists in hospitalizing the patient and making a careful examination. The solution of colloidal lead phosphate is then injected intravenously, the amount varying with the weight of the patient and the size of the tumor. The average dose has been 80 mg. of lead element, although it is believed larger doses may be safe and perhaps more efficient. Careful track is kept of the condition of the blood. The dose is repeated weekly until from 300 to 500 mg., usually 400 mg., has been given. Radiation treatment is begun when 200 to 300 mg. has been injected, and great care is taken to prevent radiation sickness. The procedures are modified according to the needs of the individual case. The patient is given a four to six weeks' rest and the treatment is repeated until the total amount of from 500 to 600 mg. has been given. Two grams of calcium lactate and one quart of milk are given each twenty-four hours, if necessary, to combat symptoms of lead poisoning. Two illustrative cases are cited.

VON WIESER, WOLFGANG. Therapy of endocrine glands in roentgenology. *Acta radiol.*, 1926, vii, 646–674.

The following endocrine disorders are discussed: mental and moral derangements, Little's disease, dwarfism, neuroses, psychoses, ovarian disturbances, dermatoses. The results of the roentgen treatment of endocrine glands vary considerably. To obtain a picture of the condition qualitatively and quantitatively the author has employed extensively two laboratory tests, namely, the gaseous metabolism

test and the Abderhalden test. The latter is claimed to give a quantitative value of the function of the glands and the former, with the information given by the latter, gives an idea as to the nature of the disturbance. Employment of these methods is believed to indicate the particular gland at fault and permits the determination of the dosage required or at least enables the clinician to tell before the onset of clinical symptoms whether there has been an over or an underdose. The methods do not, however, enable one to establish a clinical diagnosis.

Over 32,000 examinations were made on 580 patients. The tests were found to parallel the clinical conditions. The therapy founded on these tests is claimed to have yielded good results with a few exceptions even in cases of morbid irritability, mongolism and idiocy.

Little mention is made as to roentgen technique or dosage because the particular factors have not been finally worked out. In general, the dose applied to the diseased glands was between 5 and 15 per cent of the skin erythema dose. Treatment also of course included the correction of all recognizable accessory disease conditions such as tuberculosis, orchitis, syphilis, gonorrhea, etc.

WERNER, R. The technique and results of the radiation treatment of malignant tumors. *Acta radiol.*, 1926, vii, 604–625.

The numerous methods of treatment of carcinomas by irradiation represent a large scale experiment from the results of which we may obtain an evaluation of the various details of radiological technique. During its period of development radiation therapy may be said to have passed through five successive periods: (1) primitive local irradiation; (2) cross-fire through several small fields; (3) concentrated homogeneous massive irradiation; (4) indirect irradiation by roentgen-ray "bath" or selective stimulation of different organs, and (5) periodic irradiation with fractional doses of selective quality and quantity according to the rhythm of growth of the tumor.

It may be stated that under certain conditions palliative results are relatively favorable with the second, third and fifth methods of irradiation, while the end-result from any method of treatment has been found in most cases of treatment either unsatisfactory or at least very unreliable. It is therefore recommended that the technique be chosen for the various types of cancer according to the anatomical situation and the empirically determined reactivity. These should be selected for each individual case and elaborated upon. The particular procedures which obstruct the palliative effect should be eliminated even though they happen to have yielded lasting results in isolated cases.

WESTMAN, AXEL. Results of the treatment of cancer vaginae at Radiumhemmet, Stockholm. *Acta radiol.*, 1926, vii, 632–638.

A brief report is given of the radiological treatment of 21 cases of cancer of the vagina. Five of these were free from symptoms for at least six to twelve months. Only 3 of the cases were operable, 3 were on the borderline and the rest were inoperable. There were 12 cases under observation for more than five years, during which period one operable case and one inoperable case had remained clinically cured. The radiological treatment of primary cancer of the vagina does not yield very remarkable results as to permanent cure but nevertheless the facts seem to show that in certain cases it is possible to obtain a cure even of these forms of tumor which are amongst the most malignant encountered in gynecology.

The technique of treatment varied greatly. In 12 cases radium was employed; in the others roentgen and radium irradiation were combined. The radium, filtered through 3 to 4 mm. lead, was applied sometimes only vaginally, sometimes also intrauterinely or rectally. With the development of the technique the intensity of irradiation has been increased. Recently the majority of cases have received a dose of 1,500 to 2,500 mg-hr. radium element. Roentgen radiation was applied over the primary tumor, over metastases and also sometimes prophylactically, the total dose over each field being limited to the skin unit dose. Five illustrative cases are cited briefly.

WETTERSTRAND, G. A. Roentgen therapy in tuberculosis of the eye. *Acta radiol.*, 1926, vii, 639–645.

A further addition is made to the scant literature on the subject of roentgen treatment of tuberculous eye affections. The author has treated 17 cases including sclerokeratitis, uveitis and choroiditis. The results indicate that roentgen treatment in tuberculosis of the eye will probably prove fully as effective as in tuberculosis of certain other organs. In many cases the course of the disease seems to be very much shortened by local irradiation, the effect being a more rapid resorption of the granulomas. Moreover, the tendency to frequent recurrences appears to be reduced.

As in the treatment of other localized types of tuberculosis small doses of roentgen rays, $\frac{1}{4}$ to $\frac{1}{3}$ S.U.D. filtered through 3 to 4 mm. Al are found most satisfactory. The irradiation is repeated as a rule after four weeks, the number

of treatments varying according to the case from two to six. The reaction following immediately after a treatment was very moderate. Thus far late injuries have not been observed.

Emphasis is placed by the author upon the great importance in the handling of these conditions of tracing out the primary tuberculous focus and also treating that if it should be found active. Indeed, satisfactory termination of the eye condition can hardly be expected without this precaution. In the author's experience the localization of such a focus has often been in the cervical and bronchial glands. In such cases, roentgen treatment of these glands is indicated. Six illustrative cases are briefly cited.

ZAGNI, L. Metastases of malignant tumors of the testicle after roentgen therapy. *Radiol. med.*, June, 1928, xv, 549–570.

Six cases of metastases of malignant tumors of the testicle after roentgen therapy are described. The histological diagnosis was not made in 2 of the cases because they were operated on elsewhere; in 2 of the cases it was seminoma (seminiferous carcinoma) and in the other 2 teratoma. In the 5th case the histological picture of the metastases was the same as that of the primary tumor, while in the 6th case, one of teratoma with a cystic structure, chiefly sarcomatous, the metastases were sacromatous in type. In 4 of the patients the clinical signs of metastasis developed two years after the operation, in the fifth there was a local recurrence a year after the operation and in the 6th there was a metastasis in the kidney bed. The metastases followed the lymphatic tracts. Three of these patients were in moderately good physical condition when given the roentgen treatment. The roentgen treatments were given a week to a year after the operation for removal of the tumor. The other patients were in serious physical condition and suffering from intense anemia. It might even be said that they were in a pre-cachectic condition. Either immediately or shortly after the roentgen treatment there was vomiting, fever, even as high as 39.2°, headache, absolute loss of appetite, polydipsia, profuse sweating and diarrhea. After 8 to 10 treatments appetite returned and with it an improvement in the physical condition. When the irradiations were finished the patients had gained in weight from a minimum of 5 kilograms to a maximum of 37. The hemoglobin and the number of erythrocytes had increased; the leucocyte formula remained the same as it had been before the treatment or almost so, except that in some cases there was a slight increase in the number of leucocytes. Blood pressure did not change particularly. Six patients were operated on and 6 irradiated. Five of them died, 4 from generalization of the tumor and cachexia two years after the operation, 1 five years after the operation; the 6th is still living and in good condition seven years after the operation and four years after the last irradiation.

MISCELLANEOUS

BACHEM, A., and MACFATE, R. P. The question of cholesterin change after roentgen irradiation *in vitro*. *Strahlentherapie*, 1927, xxv, 476–478.

Cholesterol is broken down by roentgen rays only in solutions of chloroform and carbon tetrachloride. The effect is an indirect one through the formation of oxidizing substances, presumably oxyacids of chlorine. The object of these experiments was to determine the possibility of utilizing the destruction of cholesterol as a means for measuring roentgen doses. The results show that the above reaction cannot be employed for this purpose in the organism.

BÉCLÈRE, A. The discrepancy between the German and American measurements of the roentgen unit. *J. de radiol. et d'électrol.*, Oct., 1927, xi, 535–539.

At the Roentgen Congress in London in 1925 the author called attention to the necessity for unifying the unit of roentgen dosage. In spite of the work that has been done on the subject there is a discrepancy of 50 per cent between the German and American units. He quotes from an article by Behnken on the German unit which sets forth in great detail the instruments he made use of, the measurements of volume, pressure, temperature and intensity of current that he made and the precautions taken to avoid all possible sources of error. Béclère concludes that if, in spite of all this minute care in measurement and calculation, he cannot explain the discrepancy between the American and German electrostatic units it shows the extreme delicacy of this method of measurement and the difficulty in standardizing dosimeters when based on an electrical measurement rather than on a comparison with the constant radium ray. He says that an impartial arbiter must decide between the American and German measurements and he trusts that this important and difficult task will be accomplished by a French physician.

BERG, BENJAMIN N. Gall-bladder function after division of the common duct and

transplantation of the proximal segment. *Surg., Gynec. & Obst.*, April, 1928, xlvi, 464–469.

To determine experimentally whether the sphincter is essential for normal gall-bladder function, complete exclusion of the sphincter and complete severance of its neuromuscular continuity with the gall-bladder must be insured. In experiments of the author, the following procedure was employed in studies on dogs. The common duct was divided extramurally and the proximal segment was transplanted to another part of the duodenum. This allowed the duodenal musculature to act directly upon the wall of the duct; the sphincter was eliminated and the neuromuscular connection with the gall-bladder was severed. In order to insure firm union at the site of the transplantation, a number of weeks were allowed to elapse. Then the function of the gall-bladder was determined by serial cholecystograms made by the Graham method.

After complete division of the common duct and transplantation of the proximal segment, relatively normal cholecystograms were obtained in dogs. A specialized neuromuscular relationship between the gall-bladder and the sphincter of Oddi was excluded in these experiments and the Meltzer theory concerning bile storage and bile discharge could not be substantiated.

Boyden, Edward A. Concerning the prevalent denial of functions long attributed to the gall bladder. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 30–41.

Two radical conceptions of the gall-bladder receiving considerable emphasis in recent years deny a function to this organ. One denies that the gall-bladder plays any significant rôle in digestion, and the other claims that the gall-bladder is a passive organ. The first of these views is no longer tenable and the second is fast being disproved. Unfortunately, these two negations have become so prevalent in recent years as to occasion widespread disbelief in the utility of the gall-bladder, with the result that many unwarranted cholecystectomies are performed. It is no longer uncommon to find reputable surgeons removing normal gall-bladders with normal appendices when operating for hysterectomy or when making an exploratory laparotomy. The author shows that this procedure tends to deprive the patient of that considerable supply of concentrated bile which regularly initiates the digestion of meat and fatty foods at the beginning of every meal.

The author emphasizes strongly the importance of roentgenographing patients after meals as well as before as a routine procedure in roentgenological departments. The simplest method would be to have pictures made every five minutes during the first half hour after the patient drinks a pint of milk. This diet would not completely empty the gall-bladder but would cause the first and most important phase of contraction when the gall-bladder delivers over half of its contents. There are several reasons for adopting this procedure: First to test the contraction rate, second, for interpreting the normal shape of the gall-bladder, and third, for detecting abnormalities and adhesions. During fasting the gall-bladder is usually flaccid and its shape subject to distortion by surrounding organs. As soon as contraction sets in and bile is expelled, it rounds up and tends to straighten out, often revealing the neck and cystic duct. Numerous experiments on man and animals support these observations.

It seems reasonable to assume that in the cat, dog, guinea pig and man, bile is expelled primarily by the contractile force of the muscle tunic of the gall-bladder. With this fact assured, the important problem of the future is to find that mechanism by means of which the gall-bladder musculature itself is activated and how the flow of bile from the common duct is regulated.

Brown, A. Lincoln. The fate of iodized oil (lipiodol) in the lungs. *Surg., Gynec. & Obst.*, May, 1928, xlvi, 597–601.

Lipiodol was injected intratracheally in 2 c.c. quantities into the lungs of healthy cats. These cats were killed from one-half hour to twenty-six days after the introduction of the oil, and histological studies of the lungs were undertaken.

From these studies it appears that the presence of oil in healthy alveoli excites a mononuclear infiltration of the area involved. This mononuclear infiltration is of the large phagocytic type, apparently endothelial in origin. These phagocytes are the prime agents in the removal of the oil from the alveoli and they follow the lymphatic system, while direct absorption or digestion of the oil, if it occurs at all, is of secondary importance. At least up to four weeks there is no evidence of encapsulation of the oil remaining in the alveoli. The rate of removal of the oil seems to be in direct proportion to the number of available phagocytes.

Chantraine, H. The correct adjustment of milliamperage. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 1003–1005.

In working with currents over 100 ma.,

considerable time and operation of the tube must be expended in determining the exact milliamperage, and in this way, the tube is run more to determine a correct current than it is in actual roentgenography. One scheme to follow in testing the tube is to operate it at a lower voltage while testing the current. This serves well enough at the higher voltages but is not so satisfactory with lower voltages when over 100 ma. is required. A convenient method for control consists in making use of the cumulator of the heated filament. In order to protect the anticathode, especially when operating at high milliamperage, it is necessary to heat the filament with alternating current. The control of the milliamperage may be obtained by measurement of the voltage on the primary side of the heating transformer. By keeping the primary voltage at the same level the heating current remains constant, assuming that no changes in resistance occur in the secondary current. It is also necessary to see that all contacts in the heating circuit are good. A measuring device is necessary. This means of exact adjustment of the milliamperage without an ordinary preliminary testing, results in prolonging the life of the roentgen tube at least three-fold.

COPHER, GLOVER H., and ILLINGWORTH, CHARLES F. W. Mechanism of emptying of the gall bladder and common duct. *Surg., Gynec. & Obst.*, April, 1928, xlvi, 459–463.

The emptying mechanism of the gall-bladder is dependent partly upon an intrinsic muscular action, partly upon its elasticity and partly upon the ebb and flow of fresh bile from the liver. The last factor is of especial importance in animals in which the anatomical arrangement of the gall-bladder precludes its complete contraction, as in the monkey. Variations of intra-abdominal pressure play a minor rôle in the emptying of the gall-bladder. Peristaltic contractions of the common duct have been observed in pigeons and it is suggested that these contractions may take part in the flow of bile in some mammals. The response of the gall-bladder to a fat meal depends upon its absorption through the abdominal wall. It is not proved whether the response of the gall-bladder is due to hormone action or nervous excitation. Experimental evidence shows that sodium iodide is absorbed by the gall-bladder wall.

The above results were obtained in an investigation of this problem in which use was made of the roentgenological method of Whitaker, which consists in the filling of the gall-bladder with iodized oil and making subsequent roentgenographic studies.

COPHER, GLOVER H., and ILLINGWORTH, CHARLES F. W. Experimental study of the factor of biliary stasis in the production of gall stones. *Surg., Gynec. & Obst.*, May, 1928, xlvi, 658–659.

Clinical opinion has suggested the importance of stasis of bile, infection and the presence of nuclei in the gall-bladder as factors in the production of gallstones in the human. The authors have not been able, however, to induce cholelithiasis in experimental animals by either stasis alone or by stasis combined with infection of the bile, even in the presence of various foreign bodies. Obviously, other conditions seem necessary for gallstone formation. A likely factor may be intramural infection, especially since clinical investigation by Illingworth has shown its frequent presence in cholelithiasis even when the bile is sterile.

FREUND, LEOPOLD. On the history of "mild irradiation." *Strahlentherapie*, 1927, xxv, 593–596.

The author directs attention to the fact that he suggested and introduced the principle of roentgen therapy by mild irradiations over thirty years ago. It is also pointed out that Holzknecht, who previously was a proponent of the theory of intensive treatment, is now converted to the value of mild roentgen therapy.

GOFORTH, J. L., and SNOKE, P. O. A consideration of body resistance to neoplasia. *Am. J. M. Sc.*, April, 1928, clxxv, 504–510.

A case is reported of epidermoid carcinoma of the cervix in a patient living over eight years after a reduction of the primary lesion by combined radium treatment and surgery, and terminating by distant metastases. The natural resistance of the body to neoplasia is considered. Fibroblastic tissue proliferation and lymphocytic infiltration about the invading tumor tend to limit and prevent the progress of the neoplasm. Presence of eosinophiles is a good omen in carcinoma of the cervix and, in addition to being an important defense factor, is a valuable index of prognosis.

The treatment of carcinoma of the cervix should have as its objective a double purpose: (*a*) to eradicate the disease locally, and (*b*) to augment and build upon the natural factors of body defense. Radiotherapy approaches this dual objective more closely than does surgery. The cautery is an important aid in the technique of radium placement.

Heeren, J. New adaptation spectacles. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 1005–1007.

Experiments show that adaptation is affected not only by the color of the light, i.e., the wave length, which has been utilized in adaptation spectacles, but also the intensity or amplitude of the light source is of considerable importance. Experiments also show that this effect of the light intensity can be controlled by means of the interposition of one or more red glasses so as to compensate for the variations in intensity. Use has been made of this observation to devise adaptation spectacles provided with several red glasses of varying density which may be easily interposed before the eyes as needed. The result is that the optimum conditions for a particular observation can be quickly obtained so as to permit maximum adaptation. One advantage of these new adaptation spectacles is the reduction to a minimum of the inconvenience of wearing them, since time for adaptation is very much reduced.

Holthusen, H., and Ascher, O. The electron emission of solid surfaces in relation to the material of the radiator and the quality of exciting roentgen rays. *Acta radiol.*, 1927, viii, 51–80.

The authors consider the theoretical aspects of the intensity of secondary electronic radiations from hard metallic surfaces in relation to the quality of the roentgen rays and the material of the radiating layer on the basis of the laws of absorption. The consideration of the laws of absorption including absorption of the scattered rays, the emission of secondary radiations and the geometric conditions under which measurements are made permits definite conclusions to be drawn as regards the dependence of electron emission upon the various experimental conditions. The theoretical considerations are confirmed by the measurements of emissions excited by rays of λ_{eff} = 0.9 to 0.12 Å from such different metals as aluminum, iron, copper, silver, tin, tungsten and lead.

The following points were noted particularly: The maximum of electron emission excited by roentgen rays of decreasing wave length upon a radiator becomes evident only on examination of the electron emission in air. If the effect of radiating electrons from a metal surface is examined on a photographic film it will be found that the blackening produced by the electrons increases with the hardness of the beam.

Jansson, Gösta. The action of roentgen rays on the cell protoplasm. *Acta radiol.*, 1927, viii, 427–461.

Ultramicroscopic studies were made under dark field illumination of irradiated neutrophile leucocytes and myelocytes of human subjects. After exposure to roentgen rays the neutrophile leucocyte shows ultramicroscopically deep seated disturbances. This is evidenced in many different ways and associated with it are several forms of protoplasmic change. All degrees of progressive impairment of the protoplasm are to be noted. These are evidenced in the disturbance partly in the ameboid movements and pseudopod formation and partly in the movements of the granules and in the morphology of the protoplasmic network. The final stage of the injury is represented by death through liquefaction of the cell. During the whole stepwise progress of alteration of the cell, the protoplasm remains fluid. The different changes in the protoplasm often occur without the nucleus showing any sign of alteration.

In the irradiation of the neutrophile myelocytes, the surprising finding has been made that the protoplasm in these unripe cells reacts qualitatively in a fundamentally different manner than does that of the neutrophile leucocytes. The protoplasm of the myelocytes coagulates, whereas that of the neutrophile leucocytes liquefies. The protoplasmic coagulation exhibits various grades and a varying extent in the cell. Moreover, it appears that the protoplasm of the myelocytes is much more radiosensitive than that of the neutrophile leucocytes. In the irradiation of the myelocytes also there occur protoplasmic changes before any signs of alteration appear in the nucleus. The important result of the investigations is that cell injury in the protoplasm becomes visible earlier than in the nucleus and that the reaction in the protoplasm of the immature cell takes place qualitatively in a fundamentally different way than it does in the fully matured cell. This latter circumstance is considered by the author a contradiction to the theory of Dessauer which assumes a uniform primary effect of the rays. It appears that the type of primary effect of roentgen rays in the cell is determined by the nature of the disperse system in the protoplasm and the cell membrane.

Järnh, B. E. A new protective cap for deep roentgen-therapy. *Acta radiol.*, 1926, vii, 6–8.

A brief description and illustration is given of a protective shield intended especially for deep therapy. It has the shape of the tube and is easily adjustable in all directions. The shield is made of two layers of bakelite with an intervening layer of lead rubber. The weight of the shield is about 140 pounds.

KENNEDY, WILLIAM H., and ROW, HAMILTON. Thermocauterization of malignant growths. The use of the direct acetylene flame as a destructive agent. *Radiology*, October, 1927, IX, 304–307.

The authors describe a special acetylene torch which they recommend for use in cauterizing accessible malignant growths. It is so designed that three sizes of jets can be fitted to the same handle to suit the size of the site to be cauterized. The flame is directed through a hollow metal ring through which cold water is circulated to keep the surrounding area from being damaged, the size of the hole in the ring varying up to 3.75 cm. in diameter. The heat generated by this flame reached 3,500° to 4,600°F. Acetylene and compressed air are forced through the torch in the correct proportion to give maximum heat. By the use of this very high temperature, the authors claim to be able to rapidly remove accessible malignant growths with a minimum of discomfort to the patient. Only forty seconds were required to remove a growth 3.75 cm. in diameter. The use of this high temperature against cases of carcinoma has demonstrated its superiority over other methods of cauterization. The area being treated is visible at all times so that the extent of the destruction can be watched. Other advantages of this method of treatment are that there is no dispersion of the malignant cells into the blood stream, there is a sharp line of demarcation between the destroyed and the healthy underlying tissue (zone of about 0.5 mm. in thickness separates the two), and the results are accomplished very rapidly.

The authors have searched the literature and could find no reference to previous use of the acetylene flame for thermocauterization. This is a new method and is highly recommended in place of other means of cauterizing by heat.

KLEIN, HEINRICH V. Unusual finding in roentgen irradiated rabbit ovary. *Strahlentherapie*, 1927, XXV, 443–457.

A female rabbit at the age of nine weeks received irradiation of both ovaries from the back, the dose being 4 H through 0.2 mm. Zn plus 1 mm. Al. After this medium dose the animal continued in good condition and increased in weight. About four weeks after this medium irradiation this animal offered no resistance to the sexual attention of a vasoligated buck, but did not appear to be especially sexually excited. On the thirty-fifth day after the first exposure, another irradiation with the same dose was applied to both ovaries. Three weeks following this, there was a slight loss of hair over the back and almost simultaneously there appeared signs of pronounced estrus. She was covered three times in fifteen minutes by a vasoligated hare, and the sexual hyperesthesia lasted for several weeks. The object of the roentgen treatment was to produce considerable injury to the germinal epithelium without affecting the interstitial ovarian gland, but this purpose was not accomplished. A portion of the germinal epithelium was apparently injured with the result that the remaining uninjured portion of the germinal epithelium became stimulated indirectly to compensatory growth. The result was the appearance of increased exocrine and endocrine function of the ovary as evidenced by premature symptoms of estrus and by the fact that after covering by an infertile male, the female went through the course of a "pseudo-pregnancy." This pseudo-pregnancy was evidenced by the usual activities of the pregnant female in building a nest and preparing for the appearance of the litter. This experiment shows that to obtain exovulation and at the same time preserve the interstitial ovarian gland, it is necessary to apply a stronger irradiation to the sexually immature rabbit than the dose used in this case. This experiment seems to justify the assumption that it is possible to regulate anew and to accelerate a pathologically retarded ovarian function by means of carefully graded irradiation.

KOCH, LUDWIG. The content of chloride in erythrocytes after roentgen irradiation. *Strahlentherapie*, 1927, XXV, 470–475.

Determination was made of chloride in the whole blood and plasma and of the blood cell volume. The studies were made on 20 cases, examinations being made promptly after exposure. Three of the cases received an irradiation over the spleen (10 per cent dose); 4 received a castration dose (45 per cent dose); the remainder received one or two cancer treatments (70 per cent dose). The irradiations were produced at 180 kv., 3 ma., 40 cm. point to point spark gap, 0.5 mm. Zn plus 1 mm. Al filter, portals 10 × 15 cm. and 6 × 8 cm. The 100 per cent erythema dose was delivered in twenty-five minutes and corresponded to a value of 600 R.

In all cases there was found a volume increase (water inflow) in the erythrocytes following roentgen irradiation. In the majority of cases there also occurred a chloride migration into the erythrocytes, sometimes of considerable degree. In this particular series the cases with vagotonia proved exceptions and these individuals experienced pronounced roentgen sickness and in general reacted poorly to the irradiation. Such cases are probably best

handled by acidification or introduction of glucose (which produces an acidosis) before irradiation in order to obtain satisfactory response.

KÖHLER, ALBAN. Historical roentgen tubes 1896–1898. *Acta radiol.*, 1926, vii, 73–80.

The author describes three valuable examples of old roentgen tubes in his possession. The first tube was the type used by Roentgen himself for his experiments in 1896. This particular tube is probably the first focus-tube produced according to his directions. The second tube was made in 1898 and used by Köhler in 1899 for his first roentgenograms. The third tube made in 1898 has been used for diagnostic and therapeutic work intermittently for almost two decades. This particular tube functions perfectly to this day.

KRAUSE, PAUL. Pure barium sulphate as contrast material in roentgenology, *Acta radiol.*, 1927, viii, 120–125.

A description is given of the chemical and roentgenological characteristics of barium sulphate. It is emphasized that the pure material is entirely non-poisonous; most cases of poisoning blamed upon this substance have been due to impurities, usually barium carbonate. German pharmacies are now prohibited from dispensing anything but chemically pure barium sulphate for internal use. This is an additional safeguard. It is recommended that similar state regulations should be adopted in all countries to prevent the possibility of poisoning by this most widely used of all opaque media.

KRAUSE, P., and KRUCHEN, C. The diagnostic roentgen division of the University Medical Clinic at Münster i. W. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 996–1003.

In the construction of this diagnostic unit, the following considerations were kept in mind: The rooms should be of sufficient size and at least 3 meters high, with roentgenoscopy room, transformer room and roentgenographic room located next to one another. Floors and doors must allow easy transport of recumbent patients; no steps. Hot and cold water should be available in the roentgenoscopic room, switch room and the dark room. The electrical leads should be of sufficient size to carry all the necessary current. Modern exposure technique requires large amounts of current in a short time. An ample number of examination rooms for patients should be available, especially in a much frequented outpatient clinic.

To protect attendants and helpers against stray roentgen rays, the walls of the switch room were covered with protective tiles and the doors with sheet lead. For the storage of large quantities of combustible film an isolated store room should be provided, if possible. Fire proof chests or cupboards for films should also be provided. The roentgenoscopic room should be adequately ventilated.

KREBS, CARL. Contributions to the investigations of cancer after X-ray treatment *in vitro*. *Acta radiol.*, 1926, vii, 91–98.

Experiments on mice were made. An epithelioma was produced by painting three times weekly with tar, the area treated being on the back between the shoulder blades. After a period of six months, a scabbed cutaneous horn had developed about the size of the mouse's head. A biopsy showed a typical epithelioma. Attempt was made to transplant this tumor into 27 mice and a take was obtained in one. The tumor from this mouse was used for subsequent experiments.

Fifteen new mice were implanted with the above tumor tissue and no tumor development occurred in any of these. Nine mice received transplant of tumor irradiated *in vitro* with $\frac{1}{2}$ S.U.D. unfiltered. A take occurred in one of these animals. Twelve mice received tumor irradiated *in vitro* with 1 S.U.D. unfiltered and a take occurred in one animal of this group. Nine mice received tumor irradiated *in vitro* with $\frac{1}{4}$ S.U.D. through 5 mm. Al, with negative results. Twelve mice received tumor irradiated *in vitro* with $\frac{1}{2}$ S.U.D. through 5 mm. Al. There were takes in 2 animals of this series. Nine mice received tumor irradiated *in vitro* with 1.6 S.U.D. filtered through 0.5 mm. Cu plus 1 mm. Al, with negative results. Twelve mice received tumor irradiated *in vitro* with 1.3 S.U.D. filtered through 0.5 mm. Cu plus 1 mm. Al, with the result that 3 animals showed large takes.

The radiations used were such that 1 S.U.D. unfiltered was equal to 1 Sabouraud-Noiré and equivalent to about one-half the fatal dose for a mouse. Further, 1 S.U.D. through 5 mm. Al equals 4 Sabouraud-Noiré and is equivalent to the fatal mouse dose. One S.U.D. through 0.5 mm. Cu plus 1 mm. Al is equivalent to 4 Sabouraud-Noiré and is a little more than a fatal mouse dose.

The above experiments indicate that an artificially produced squamous cell epithelioma in a mouse cannot be killed *in vitro* by the roentgen-ray doses which are generally used in therapy.

LACASSAGNE, A., and GRICOUROFF, G. The effect of irradiation on the leucocytes of the

blood studied by the culture method. *J. de radiol. et d'électrol.*, Nov., 1927, xi, 573–580.

The experiments consisted of making cultures of rabbits' leucocytes after the animals had been irradiated and of irradiating *in vitro* leucocytes taken from non-irradiated animals. Both roentgen and radium rays were used. It was found that roentgen or gamma rays even in large doses do not prevent emigration of leucocytes. Beta rays cause rapid death of all the cells. In hanging drops the polynuclears survived the same length of time in the irradiated and the control specimens; they rarely survived more than forty-eight hours in either. Cultures of leucocytes taken from rabbits a few days after irradiation showed that the polynuclear cells are only slightly radiosensitive. The cultures of lymphocytes were particularly active. Though many of them degenerated within the first few days others survived longer and sometimes became transformed into macrophages. They did not show very great radiosensitiveness either but it was greater than that of the other leucocytes; it differed in degree for different lymphocytes in the same specimen. The monocytes, the numbers of which are not very greatly changed in the course of the leucopenia following irradiation, did not show great radiosensitiveness in vitro; they were transformed into macrophages in the irradiated specimens as well as in the controls.

The leucopenia which results from experimental or therapeutic irradiation cannot be attributed to destruction of the leucocytes in the blood, either by direct action or by the liberation of a leucotoxin. It is the result of lesions produced in the leucopoietic organs by the rays and the temporary arrest of production of new leucocytes.

LAURELL, HUGO. Respiratory changes in the lung field, mediastinum and diaphragm under normal conditions and in certain diseases of the lung and the pleura (preliminary report). *Acta radiol.*, 1927, viii, 555–562.

A discussion is given of the effect of respiration on the blood distribution in the various vascular regions of the lung and in the heart; in addition, the effect of posture upon the blood content of the lungs and the heart and also on the volume of the circulating blood is considered. The pumping action of the atrioventricular septum is closely related to some of the phenomena. In spite of increased external pulsations of the heart, the stroke volume may be considerably decreased. Evidence is presented for the existence of a slight normal respiratory pendular swing of the heart. Mention is also made of the pronounced pendular displacement (to the diseased side on inspiration) of the mediastinum such as is seen in bronchiectasis, pneumothorax and pleuritis. A discussion is also given of the physiology involved and the causes for distinct volume changes undergone by the heart in cases of retarded air flow from and to both lungs.

LAZAREW, N. W., and LAZAREWA, ANNA. Changes in the functional state of the blood vessels after roentgen irradiation. III. The question of the so-called "latency" of the roentgen-ray effect. *Strahlentherapie*, 1927, xxv, 458–460.

In the first series of experiments rabbit ears were isolated by the method of Krakow and irradiated. Preceding, during and after the irradiation the excitability of the vasomotor apparatus was studied pharmaco-dynamically; one of the important tests was the flow per minute of Ringer-Locke solution perfusing the ear. In another series of experiments the ears were not removed from the animal and the examinations were made microscopically before, during and after the irradiation. Confirmatory observations were also made on the tongue and web of the frog, on the ears of white mice and rabbits, and on the vessels under the human nail.

The following conclusions are drawn: During irradiation of the isolated rabbit ear no changes in vascular tone and in the irritability of the vasomotor apparatus were noticeable. On prolonged irradiation (two to three hours) of the isolated rabbit ear, a gradual change in the vascular tone and in the rate of perfusion could be observed; similar variations in tone occurred, however, in the control ear of the same rabbit (the control was isolated like the experimental ear but was unexposed). The whole question of the effect of roentgen rays upon the vessels of isolated organs requires further experimental investigation.

During an irradiation of one region in a living animal, no changes in the circulation and vascular diameter were noted in other localities. Changes in the capillaries underneath the human nail first appeared after a fairly long interval from the time of exposure with the following factors: 60 kv., 3 ma., 1 mm. Al, distance 27 cm., duration 23 minutes, does 9 X (about ½ skin erythema dose). Since these changes occurred quite slowly, it was difficult to determine the exact moment of their appearance. All that can be said is that it took several hours for the phenomenon to appear. The authors do not find in these observations any confirmation for the assumption that the nervous apparatus of the vascular walls is the

point of attack of the primary roentgen-ray effect.

LEVY-DORN, MAX. Legal decisions regarding injuries by roentgen rays. *Acta radiol.*, 1926, vii, 147–164.

The author reports briefly on 15 different cases decided by the courts in Germany involving certain remarkable failures in the use of roentgen rays, certain important questions regarding roentgen injuries submitted to court decision and the attitude taken by the court in such cases. The original must be consulted for details.

LITTLE, CLARENCE C. Agents modifying the germ plasm. *Surg., Gynec. & Obst.*, January, 1928, xlvi, 155–158.

There is no possible way to be sure that any treatments of the gonad with radioactive substances which cause death or inactivity are not also producing in other sex cells of the same individual malformation or internal upset. This fact is of primary importance and cannot be safely ignored. The very fact that results of exposures to radioactive substances do not always produce the same results is one of the reasons why, in employing them, medical practitioners should proceed with the utmost caution.

The germ plasm is modifiable by certain agents which affect it directly. Radioactive substances are among the most powerful of such agents. Any agent which kills germ cells bears the possible power of producing inactivation, malformation, and genetic changes when used in decreasing amounts or strength of exposure. The duty of medical men to future generations demands: (*a*) that accurate systems of human records be established; (*b*) that medical men keep up to date with advance in experimental genetics; (*c*) that they use extreme caution in advocating the use of agents which may affect the germ plasm in young individuals or in individuals of reproductive age; (*d*) that they discourage acceptance of results based on control data insufficient in number and inadequate; (*e*) that they encourage inclusion wherever possible of courses on experimental methods and scientific criticism in the premedical or medical curricula.

LOSSEN, HEINZ. Results of a review of cases of accident and injury in roentgen establishments in Germany. *Acta radiol.*, 1927, viii, 345–362.

As a result of the plan proposed by Groedel, a collection is being made of roentgen accidents and injuries. The present report includes a total of 183 cases of which 4 were erroneously reported as roentgen injuries. Six of the cases were chronic roentgen injuries. Of the 53 cases of roentgen injuries incurred during diagnostic procedures, 27 occurred during roentgenoscopy, 15 in roentgenography and 8 in a combination of the two. There were 120 cases injured in therapeutic procedures; 58 of these received surface therapy and 62 deep therapy.

A certain number of the injuries were associated with combination of chronic external irritation which may have been responsible for the appearance of the late roentgen injury, another group of cases represented individuals suffering from cumulative effects of numerous treatments or overlapping of fields, incorrect dosimetry readings, activation of tuberculosis and improper after-treatment.

The analysis of the present group of cases shows the following contraindications to roentgen irradiation:

Absolute Contraindications: Active roentgen injury.

Relative Contraindications: (1) Inactive roentgen injury; (2) infancy and childhood; (3) pregnancy; (4) diseases (*a*) of the skin (eczema, hyperidrosis, psoriasis, warts); (*b*) constitutional diseases (Addison's disease, diabetes insipidus and mellitus, gout); (*c*) Basedow's disease; (*d*) infections, especially tuberculosis; (*e*) nephritis; (*f*) marasmus; (5) scar tissue; (6) medication with adrenalin, quinine, iodine, salvarsan, terpenes, irritating salves, plasters, poultices; (7) physico-therapeutic treatments; (*a*) radiant energy (sunlight, ultraviolet, Finsen treatment); (*b*) radiotherapy with radium, mesothorium, etc., and (*c*) hyperemia with stasis.

LUNDQVIST, ARVID. The effect of total roentgen irradiation on the metabolism. *Acta radiol.*, 1926, vii, 172–188.

This report is concerned with calorimetric studies on mice. A modified method is described for determining the heat loss of mice by the compensation principle. The average error of the method at 20°C. is about ±10 per cent. The heat loss was followed in healthy animals at different external temperatures as well as of animals with a body temperature greatly reduced by starvation. In 31 mice completely exposed to roentgen rays no definite changes could be detected in the heat loss. The roentgen doses varied from 0.1 to 3.2 S.U.D., values which extended several times beyond the lethal limit. In spite of this the calorimetric observations could reveal no changes that might be interpreted as due to an altered metabolism.

LYSHOLM, ERIK. A roentgenoscopic modeling apparatus useful also for cross section and localization. *Acta radiol.*, 1926, vii, 189–192.

The purpose of the apparatus is to prepare plastic models of organs as seen during a roentgenoscopic examination, the shape and size of the models being exact counterparts of those seen in the body. The construction of the apparatus permits the patient, sitting on a stool, to be rotated by degrees simultaneously with and through an equal arc as the plastic material. The screen examination is made at a distance of 2 meters (or orthodiagraphically). With an indicator pointer the various contours are drawn out as they appear on the roentgenoscopic screen. The indicator arm is fastened to two arms movable at right angles to the roentgen beam. A projection of the indicator consists of a tightly stretched piece of piano wire which cuts sections out of the clay, corresponding to the outlines depicted on the screen. The model is finished when the patient has completed an entire rotation. The apparatus can also be used for obtaining cross-sections of different parts of the body, for instance, the heart. It may also be readily employed for the localization of lung abscesses or of foreign bodies.

LYSHOLM, ERIK. Combined urology- and Bucky table. *Acta radiol.*, 1927, viii, 263–269.

The author describes a combination of urology table with Bucky diaphragm which offers wide range of utility. The table can be elevated and lowered by means of an oil pump and may be easily swung in various directions. It enables one to take rapid roentgenograms at different angles and in different planes and to make a detailed roentgen analysis without having to touch or turn the patient.

MANNL, R. Stereoscopy of movements during roentgenoscopy. *Fortschr. a. d. Geb. d. Röntgenstrahlen*. 1927, xxxv, 779–780.

Attention is directed to the possibility of viewing the simple roentgenoscopic picture so as to yield an image of plastic movement. This is accomplished by rapid shift of the roentgen tube as recommended by Holzknecht for pulmonary examinations. By using monocular vision the effect of moving the tube is to give the sensation of a stereoscopic view.

MARTIUS, HEINRICH. Roentgen-ray measurement in R units. *Acta radiol.*, 1926, vii, 193–200.

The necessity for roentgen-ray standardization has led to the creation of the roentgen unit (R unit) which may be considered a physically exactly defined, absolute measure capable of duplication at any time or place. When introducing this unit for practical purposes it must be remembered that a given value for R holds good only for the ray hardness at which the calibration was made. Attention is directed to the difficulties in estimating the effect of secondary radiations. The author proposes for the present that the introduction of absolute measurements of radiations should require merely the value of the primary beam in R units, together with information concerning the hardness of the radiation, fields of exposure, focal distance and time of exposure.

MCCUTCHEN, L. G. New device for the reduction of fractures. *Radiology*, October, 1927, ix, 308–313.

A new device is described which can be attached to the operating table or the ordinary roentgenographic or roentgenoscopic table which can be used for reducing fractures. It exerts a pull equivalent to that of six men. Illustrations are given with full description. It is constructed of aluminum and is portable, requiring but three minutes to put in place on the table. It can be used for upper or lower extremities with equal ease. Since it is portable and can be attached to any table, it eliminates the necessity for a separate fracture room.

NEUGEBAUER, FRANZ. The safety lock against error in using filters. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1927, xxxv, 975–978.

Filter safety devices may be broadly divided into two classes: (1) those utilizing some visible or auditory sign to warn the attendant, and (2) those automatic in type which control operation of the tube. It appears to be unwise to use one type to the exclusion of the other; a preferable scheme is to use both to supplement each other. One disadvantage of automatic devices now in use is that they prevent operation of the tube if a filter is omitted but do not give warning if a wrong filter is inserted. The author describes a safety lock for filters which operates automatically and makes it impossible to accidentally interpose the wrong filter. The original should be consulted for details of construction.